RECREATIVE SCIENCE.

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THE HEAVENLY SYMBOL OF HUMAN KNOWLEDGE.

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In every manifestation of Almighty power there is of necessity a reflection of Almighty attributes, just as the infinitely meaner human artist infuses his own mind and moral nature into the cold marble that shall smile with beauty, or the dull canvas that hereafter shall delight the world. Is there not in man a threefold nature, a physical being, subject to the laws that control all other forms of matter, a frame of dust that lives and dies: an intellectual nature, that sparkles during life, and leaves a track of light behind like the phosphorescence in the wake of a ship, and by which we bask in the radiance of the thoughts of the departed: a moral nature, susceptible of the influences of love, of fear, of hope, and that culminates to its highest in the blessed joys of devotion—that dies not, but shall adore for ever? The threefold nature of the Divinity is shadowed forth in man as its highest earthly image, and did we but know sufficient of the inner constitution of the things that surround us, we should doubtless discern a triple constitution in every object of creation. Look at the rainbow, a million disjointed water-drops that assume the form of a solid structure, spanning earth and heaven in a vast embrace that seems sufficient to make them one for ever. It has but three colours, out of which its varied blendings of harmonious tints are all compounded. It is the appointed symbol of the covenant that water shall not again consume the race of man, and that seed-time and harvest, and summer and winter, shall never fail. Compare it with the forms of human knowledge, and Earth, Air, and Water testify to the unity of the plan on which an eternal Godhead worked when time began, and still works in sustaining the fruition of the first creative impulse. Resolve your sciences back into their primal sources, and Animal, Vegetable, and Mineral testify of the same analogy, notwithstanding the long list of elements the chemist would adduce to nullify these promptings of imaginative perception. From the rainbow pass to the subdivisions of our knowledge, and as the red rays mingle with the violet on the one hand, and with the yellow on the other, melting into mixtures of indefinable gradations, tone softening into tone with intermediate harmonies, so all science presents gradations of thought and subject, and no man can affix the boundary lines of any. Take our systems of classification, and the more they profess to be natural, the more do they prove to be unnatural, and perhaps, after all, the strictly artificial may prove the most useful in the end, as aids to memory and association of ideas. Jussieu may plan and Lindley may improve upon the foundation laid for him, and Owen and Agassiz may add to Cuvier's giant accomplishments; but everywhere plants and animals creep out of the classes to which they have been assigned, for between all orders and classes Nature interposes her connecting links, saying with defiance, "Draw the line between them." True, we must classify as best we may, in order to localise our thoughts and put items of knowledge into their proper places; but let us never forget that creation was not designed in orders and classes, but in one glorious and complete system, in which at various periods there may be striking forms that apparently stand apart, just as in the rainbow the primal colours quickly catch the eye; nevertheless between these the insensible gradations are so many, and so indefinable, that all classification fails when put to its professedly ultimate objects.

It is the same—as it must be—in the divisions of our knowledge. We may classify and talk of botany as in no way related to the knowledge of the planets, but a higher law, springing out of the oneness of the vast creation, unites all together; and we cannot learn the whole history of a wayside weed without also knowing something of the movements of the stars in their courses. The quick eye of the student perceives a strange beauty in some rare shell; he cannot analyze the secret of his pleasure, but he will study shells, form a collection, and search abroad for such treasures of the watery depths, that each may give a new delight in the observation of its form and colour. Now he is seized with a hunger to know what sort of creatures once inhabited those sculptured chambers—what strange life had its home in this neat Nerita, or this spiky Pteroceras. Why should each be an architect of a school different from all the rest, and fashion from the slime of the deep forms that man himself has ofttimes devised in his own ornate fancies? He looks inward and a door opens. He sees before him the vast array of animated being, leading off from simplest rudimentary forms, through insensible gradations, to the other end of the thread of life, on which the creatures are all strung as a series of variously-coloured beads. The sphynx within him has propounded an enigma, and zoology must be the Œdipus to set him free. But he never will be free; he is drawn forward by a greater than magnetic force, and ere he has accomplished one-half his chosen task, he discovers that some beads have fallen from the thread—some of the animal forms necessary to the explanation of the order of creation lie buried in the stony strata, where they silently witness the story of their birth, and lifetime, and extinction. He will now grope through the dark labyrinths of geology, and while reading "sermons in stones," speculate anew on the successive phases under which the Fatherly Wisdom worked, about which the shell first set him thinking. The enchantment deepens, mighty bones of perished reptile, bird, and animal take shape as in the flesh, and solemnly pronounce, that on the great gravestones of the world, where perished races sleep the sleep of ages, are inscribed the letters needful to spell out the order of created being; for like the rainbow, life in its whole plan is a gradation of details; it melts from form to form, and from colour to colour, so that distant parts may contrast, though inevitably tied together by intermediate unities. He learns that creation is a wondrous whole; it is the fancy of the human mind to attempt its separation. The internal structure and the order of the strata become thenceforth the necessary objects of his study, and he has now taken hammer in hand, and finds a new pleasure in hunting after fossils, descending quarries, and estimating the angles of dips, and the superficial distribution of this or that great platform. What! study geology, and give no heed to those vaster phenomena of which geologic facts are but the secondary consequences? Is the figure of the earth, the disposition of land and water, the rising and falling of the tides, the attractive forces of sun and moon—is any such great energy to be counted nought by him who has already passed the limits of sectional knowledge, and taken a bold flight after the universal? He will become an astronomer, and geology shall propound him one great question as to the past history of the elements of which the earth consists, and he shall look out to the nebulæ of Orion for an answer. He must also connect, in thought, the strata in which his fossils repose with the daily march of the sun, and the melodies of the myriad stars that glide across the midnight. He has been led on, not merely because knowledge is in itself a talisman, and works a magic influence on the brain of man, but because, in the infinite plan of the infinite Worker, the parts are indissolubly connected, the variously-coloured threads are woven into one great pattern, of which we see perhaps only the reverse side, and even then enough to prefigure the completeness and glory it must have to the wisdom that sees the whole aright.

In the midst of his pursuits, the student pauses to apostrophize the sign of the covenant as it spans the earth in an embrace of love. It is lost on either hand in the mists of the horizon, but the boldest and brightest sweep of the bow bears above it the blue heaven, and he can believe the old poetic fancy that it is the pathway on which ministering angels descend to man with messages of mercy. Is it awe, is it wonder, is it adoration that most influences the trembling searcher after truth, as, in the presence of the rainbow, he offers his soul to God as an unworthy creature? Is it power alone, the affluence only of an exhaustless energy that needs but to will and it is done, that gives the rainbow its perfect form as a type of heavenly things—its perfect harmony as the reflex of all thought and the order of all created beings? Is it not also the emblem of Divine tenderness, and sympathy, and compassion, so that the very rain-drops that splash from it on the green herb sing the praises of the Lord, and have for the burden of their song this monition for us—" Wide as the rainbow stretch the arms of faith, and seek happiness as the reward, not of proving, but believing."

The greatest charm that science has in store for those who reverently woo her, is in showing them the ultimate relations of all things, one to another, throughout the universe, in which man—a dim speck—has been divinely taught the name of his Maker. As " book openeth book," so every truth is a key to another truth, and we see how the heaven-piercing hills, that in their grandeur of piled rocks and awful escarpments seem made to last for ever, are yet powdered into dust by midnight dews and changeful breezes and the pretty lichens that cringe to the clefts, slowly distilling upon them solvent acids. Can I look at the pretty fabric of the honey-bee without being led into speculations in mathematics? Can I behold a trembling dew-drop on a rose-leaf without reflecting on the force of coherence that holds the atoms of a world together? Can I pierce the heart of an oak without beholding there the pencilling of the sunbeam a hundred years ago?

The rainbow is not only the sign of peace, it is also the symbol of knowledge, and when we bring even that within the grasp of our inquiries, and resolve its spectrum into its components, only to discover that there are deeper and unfathomable mysteries in the prismatic glitter of falling drops of water, let us uncover our heads, and in the presence of a present harmony which is a shadow of the eternal harmony in which all visible things are as component colours, give the glory and the praise to Him, who, having created them all in wisdom, now sitteth on the throne judging us in righteousness, while sustaining the universe in the hollow of His hand.

SHIRLEY HIBBERD.

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SPONGE-HUNTING IN HOLY ISLAND AND BERWICK BAYS.

It is of no use frequenting Holy Island or Berwick Bays, which more especially figure as the scenes of success in the acquisition of specimens, without having in hand the very able and beautiful manual of the late Dr. George

The Doo Coves, near Cockburnspath.

Johnston, of Berwick-upon-Tweed. With the help of that volume, however, may be managed a tolerably complete *repertoire* of sponges and lithophytes. Of the numerous and important family of British sponges, the following numbers of *species* may be enumerated under each *genus*:—*Tethya*, 2; *Halichondria*, 18; *Spongia*, 1; *Grantia*, 5; Doubtful species, 14;—that is, restricting the name of *Spongia*, according to the classification of the late Rev. Dr. Fleming, to such as have the axis or skeleton composed of horny tubular fibres, giving the name of *Grantia* to those whose skeleton consists of calcareous spicula, and that of *Halichondria* to such as have siliceous spicula as the basis of their structure, but separating from these the *Tethya*, because of the peculiar arrangement of their spicula, and the hemispherical form of their bodies.

Dr. Johnston's labours, indefatigable as they were, have added but sparingly to the list just given. Indeed, he acknowledges that, notwithstanding their extent, the British shores cannot be deemed favourable to the production of sponges, for the indigenous species in general give proof that our waters are unfavourable to the race by the rarity of the normal species, and by the dwarfed size and compact structure of the others. Of the genus *Spongia*, I speak but of one, and Johnston himself refers to but two inconsiderable representatives. About a fourth part of them are calcareous; but the great majority are secreters of silex, which they, like skilful artificers, fashion into crystalline needles, and interweave with the parenchyma of their bodies. Of the *Tethya*, Holy Island and Berwick Bays cannot boast. Indeed, the only locality marked for them is that of the Hebridean island of Feulah, by the late Professor Jameson; although Dr. Fleming announces that it adheres to stones in deep water in Zetland, where it is termed sea-apple.

Passing into the *Halichondria*, the splendid *H. palmata* assuredly habitats near Holy Island, and on some parts of the coast of Berwickshire. It is a sponge-like plant, rising from a spreading base to the height of occasionally nearly two feet. Indeed this "Mermaid's Glove," as the Shetlanders style it, is undoubtedly the largest and finest of the British sponges. The erect and bushy *H. oculata* is not uncommon on the Northumberland coast, and is frequent in the Firth of Forth, being sometimes discovered growing from the wandering back of the living Hermit Crab, when it forms a desirable object, of course, for the aquarium. Indeed, the *H. albescens* is likewise found parasitical on *Sertulariæ* in Berwick Bay. But to return to *H.*

oculata, Pallas locates it thus, "*mare inter Anglium et Belgium.*" Ellis says it is found very common all round the sea-coast of these kingdoms; and Fleming seems to make no difficulty of finding it hanging from the under surfaces of rocks about the low water mark of spring tides. Not so readily will *H. plumosa*, described by Montagu as *Spongia plumosa*, "Coast of Devon, rare," be met

Halichondria oculata, or branched English sponge, growing on the back of Hyas aranea (a small crab).

with. The search indeed baffled Johnston, and may as well be renounced by a stranger. He had imperfect specimens, indeed, sent to him of a sponge supposed to be this species, but they did not accord with Montagu's description. Nor did a visit to the British Museum throw any light on the matter; for it seems that the collection of sponges made by Montagu is not included amongst his other collections in that noble institution, so that, to the misfortune of science,

Halichondria palmata, with small specimen, spicula and oscula.

it has become almost impossible to identify some of Montagu's species, or even to ascertain their proper genus. I should have expected to find *H. fucorum* in these locali-

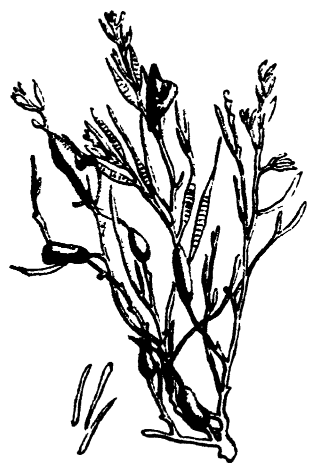
Halichondria albescens.

ties, but cannot say with certainty that it will be found. It is by no means uncommon, and is found investing *fuci* and corallines.

Fleming describes it as frequent on *Sertulariæ*, sometimes following the course of the branches individually, which it envelopes; at other times spreading laterally, and uniting the branches together, thus becoming an unformed mass. In texture it is rather coarse,

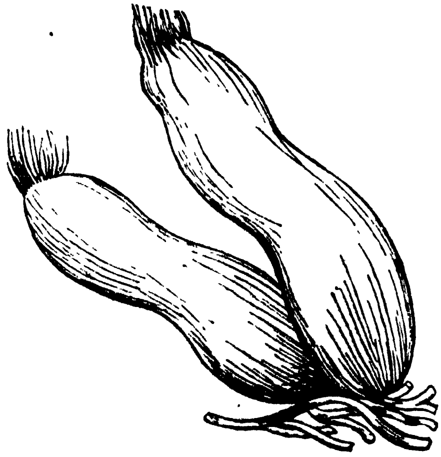
Halichondria panicea.

and the fibres imbricated. Sometimes it occurs in considerable masses at the base of *Sertularia antennina*, and other vesicular corallines. I suspect, however, it is not much found in Berwick Bay, as Johnston's own



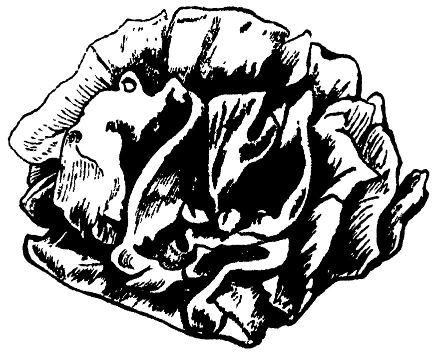
Halichondria fucorum.

specimens were from the western shores of England and Scotland,* and my eminent friend, Mr. W. Thompson's, are from the Irish coasts. Johnston, nevertheless, had seen it in a crustaceous state (not good for specimens), spreading on the surface of a rock, so very like the primary condition of *H. palmata*, that the distinction could not



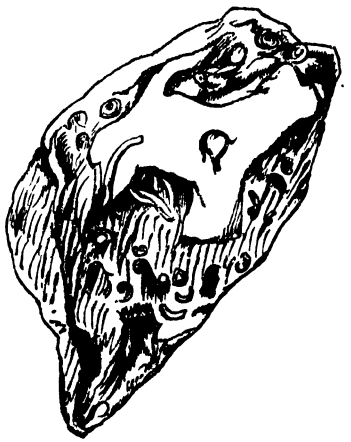
Grantia ciliata in a growing state.

have been made without an examination fo the *spiculæ*. The *H. panicea* is, however, very common, not only here, but on all parts of the British coasts, being largely dif-



Spongia pulchella.

fused on rocks, between tide-marks, on crabs, shells, and corallines, and on the roots, stalks, and fronds of the larger *fuci*, and in vast profusion. You will easily know it. It forms that irregular, and often very extensive, orange-yellow crust of from an eighth of an inch to nearly an inch in thickness observed upon these objects. Nothing, at the same



Halisarcha Dujardinii.

time, can be more various than the appearances which *H. panicea* is pleased to assume in different sites and locations. On sea-weeds and corallines it forms a thin crust, which, after being dried, becomes (as most coloured marine objects—even the most beautiful and brilliant corallines, by the by—inevitably do if exposed to dry air) of a snow-white colour, and may thus readily be mistaken for *Grantia nivea*, the only mode of detection being examination of its structure. In its normal state the surface is smooth, but evenly ridged or lobed, with the pores so fine as to be imperceptible when the sponge is fresh, and just visible after it is dried; whilst the fecal orifices are scattered, and either level, or very little raised. It is very common on rocks near low water-mark, and often surrounds the stem of *Laminaria digitata;* nor is it uncommon on some crabs, Hyas and Inachus, which it entirely envelopes. When dry, this sponge is pliable. But beware! its powder possesses the property of producing a most intolerable itching when rubbed into the skin, as some mischievous boys of my acquaintance pretty well know. Even if dried in an oven, this peculiar power of stinging, far from being removed, is considerably increased. *H. celata*, which Grant finding on the oyster-beds off Prestonpans, Inchkeith, and in the roadstead of the Firth of Forth (by dredging), set down as a polyp, Johnston and Bowerbank, as well as the late Professor Edward Forbes, agreed to class as a *Halichondria.*

There is to be met with sparingly, habitating amongst the Holy Island coves, a remarkable species, the *H. sanguinea*, forming an undefined crust of a uniform deep red colour, becoming orange-red when dried, and one-eighth or one half-inch in thickness. At Coldingham, near St. Abb's Head, we meet with *H. suberea*, generally seen encrusting dead univalve shells. One thing very remarkable relating to this, has been observed by Montagu, and can be perfectly confirmed. It is, that few instances occur of its being so found where the Hermit Crab has not formed a lodgment in the nucleus of the shell, and there appears to ensue a formidable struggle between these two parasitical intruders. The sponge is perpetually attempting to fill up the aperture of the shell, whilst the crab, by its occasional emanation in search of prey, frequently frustrates this propensity of the sponge. At last, notwithstanding the frequent efforts of the restless intruder, the steady increase of the sponge insensibly gains upon the tenancy of the crab, pushes it off upon all sides, insensibly lines the interior of the shell, and thus the crab, finding his abode becoming too small, is incontinently compelled to seek out another home. The *Spongia pulchetta* and *S. limbata* are two specimens occurring in Berwick Bay; and of the *Grantia, G. compressa, G. ciliata* (attached to *Corallina officinalis*), and the encrusting sponge, *G. coriacea*, besides. But I do not think that *G. nivea* occurs nearer than Dunstanborough Castle.

The remaining order of sponges, the *Halisarcha*, or "marine flesh," are also to be picked up in Berwick Bay and Holy Island. *H. albescens*, parasitical on *Sertulariæ* in Berwick Bay, and *H. Dujardinii*, on the under side of stones, and commonly on the undershoots of *Laminaria digitata*, between tide-marks, both in that bay and at Holy Island.

WILLIAM WALLACE FYFE.

Dorchester.

A Flower of Minnows.

NOTES ON A FEW RIVER FISHES.

FEW subjects are more interesting to a British naturalist than the fresh-water fishes of our island, and this the rather as they come more immediately within the scope of our personal observation than do their relatives of the briny sea. Our present design is to say a few words about some of the smaller species, which are more attractive to the schoolboy than the angler, unless, indeed, the latter wishes to employ them as a bait. Little shall we expatiate on the trout,—its history would require pages. We may, however, observe that it varies greatly in size and colour in different streams and rivers, or lakes. For example, in the rivers of Derbyshire and Cheshire, it is far smaller than in the Thames at Maidenhead, Sunning, Pangbourne, and still higher up the river. The same observations apply to our large lakes, where the parr, an allied species, accompanies it, as well as the great gray trout (*Salmo ferox*), which is recorded to have been taken in the Ullswater, weighing upwards of fifty pounds. We have seen very large specimens from Loch Awe and Lough Neagh. To revert to the common trout (*Salmo fario*), we may observe that, in clear, rapid streams, where, as we have said, it never attains to a large size, it is, when in season, very brightly coloured and adorned with vermilion spots.

But, as we can testify, there are certain rivulets which traverse the coal-shale strata in Derbyshire, small feeders of the Wye (near Buxton), which contain trout of a very different tone of colouring. These waters appear to be stained with an inky dye, and the trout they contain are also remarkable for the dark, dull black tone of their colouring, as if influenced in this respect by the water. They live in deep, abrupt holes, and in hollows under the bank, often of considerable extent; and also under large half-upraised slabs of shale. We cannot doubt but that these fish travel to the Wye—and very short is their course. But in this clear, bubbling, rapid stream, their colour undergoes (and, as we think, speedily) a great change. They become bright-coloured and beautiful, losing their inkiness. We do not forget that young fish are usually dark; but it is the peculiar tone of darkness which has always attracted our notice, the more so as many examples which we have seen were not very young, inasmuch as they have measured from seven to nine inches in length. Although, as we have said, in small rivers running over a rocky bed, the trout does not attain to a large size, at the same time their flavour is excellent. On the other hand, in large streams, affording an abundance of food, they often attain to a surprising size, and are of most superior flavour. One of our leading naturalists, an unerring sportsman, both with gun and rod, has shown us trout (*Salmo fario*), taken by himself, some at Pangbourne, others near Maidenhead, of unusual magnitude and perfection of contour. The weight of the finest ranged from eight to ten and a-half pounds; one was eleven. It was placed upon the royal table at Windsor. These fish were caught by a single gut—a fact proving the tact and cool skill of the angler.

Trout-fishing in Norway!—what a subject upon which to dilate; but we must draw in. Setting aside the salmon (*Salmo salar*), which divides its time between the river and the sea, the trout is the aristocrat of our fresh-water fishes, although the *true* salmon-trout (*Salmo trutta*), a very different fish from the grilse, or salmon-peal (the young of the salmon), and the parr (*Salmo salmulus*), are by many considered as its rivals. They may be so, but then they are not so generally obtainable. There is, however, another fish called the grayling, local in its range, and therefore not often to be seen on our tables, which almost equals the trout; and then there are other fish of this group, viz., the bull-trout (*Salmo eriox*), the vendace (*Corregonus Willoughbii*), and the gwiniad (*Corregonus ferus*), these two latter said to be as excellent as they are rare. We shall not here attempt to enter upon a history of the British *Salmonidæ* (to which the smelt, *Osmerus eperlamis*, belongs), but we cannot altogether pass by the grayling, the rather as we are well acquaintd with it from personal observation.

The grayling (*Thymallus vulgarus*) is, as we have said, local in its distribution. There are many rivers abounding with trout, which do not produce its relative the grayling, yet it requires the same clear water, and might be supposed to exist where the former is plentiful. Such, however, is not the case. In the rivers of Derbyshire, to which we have already alluded, the grayling is common. It occurs also in some of the rivers of Hampshire, Wiltshire, Shropshire, and Staffordshire, as well as in those of Lancashire and Yorkshire. It is said to be plentiful in those of Sweden and Norway.

The grayling is an elegant fish, remarkable for the expansion of its dorsal fin. This peculiarity renders it a bad *springer-up* out of the water, and prevents its making head against a strong current, or leaping over a waterfall, which the trout would clear with ease, as a hunter clears a five-barred gate. Hence it prefers the deeper and more tranquil reaches of the river, where it feeds like the trout, wanting, albeit, that energy which in the latter so often tests the angler's skill. The grayling, as we can testify, is a great delicacy for the table; it has, indeed, been called the flower of fishes; and its generic name, *Thymallus*, has been bestowed upon it from the peculiar odour of thyme, of which, when fresh out of the water, this fish is delicately redolent. This aroma goes off in a few hours, hence the fish cannot be dressed too soon. A good-sized grayling averages from eight to twelve inches in length; occasionally, larger specimens are taken. It is in May and June that the trout is in perfection. This fish spawns, as a general rule, in October, or rather from the latter part of September to the early part of November; allowance must here be made for the influence of lakes and rivers resting upon or passing over strata affording a plentiful or a meagre supply of food, circumstances greatly influencing the size of the fish. and the high flavour of its flaky flesh. But the grayling spawns in April, and even in May; consequently, it is out of season when the trout is in full season. We must wait for the months of October, November, and even the beginning or middle of December, for the grayling. Fishing for grayling in November and December is cold work. Nevertheless, we have known those whom the cold has not deterred from following their "avocation." Hence, perhaps, we hear so little of the grayling, and so seldom see it introduced upon the dinner-table. We have ourselves fished for it, and been rewarded; but we confess that its capture will not give much excitement (setting the cold aside) to the impatient angler. It is not a dashing fish. It makes the rocky or gravelly bed of the deep stream its home, and whipping with a fly (artificial, of course) will not avail, that is, if we may judge from our own experience. Different rivers, however, may require differences of treatment.

We may here, perhaps, inform the reader that the *Salmonidæ*, or salmon family, are among that section of osseous fishes, the skeleton of which contains in its composition true bone corpuscles. We shall make ourselves better understood by the following comment:—Fishes are usually divided into two great sections, viz., *osseous fishes* and *cartilaginous fishes;* the former having a bony, the latter a cartilaginous or gristle-like skeleton, as the skate, the ray, the shark, etc. Now, late microscopical investigations have shown that amongst the so-called *osseous fishes* numerous species, nay, entire *genera*, are found in which the skeleton is destitute of bone corpuscles, that is, a deposit of bone particles in its composition. Their bones, therefore, though firm, are not truly bone, and, in many cases, their composition closely resembles the structure called *dentine*, a sort of *enamel*, largely developed in the teeth of many quadrupeds, and essentially different from *bone*. This composition in the skeleton of fishes has been termed by M. Kölliker, *osteoid*, *bone-like*, but *not* bone, inasmuch as bony particles, or corpuscles, are altogether absent. In many cases this dentine is structureless, in others it seems to consist of a mixture of fibres composed of *osteoid* and cartilage. Hence, therefore, whole groups among the *so-called osseous fishes* have *not*, in truth, a *real osseous skeleton.* As familiar examples, we may mention the pike, the perch, the mullet, the atherine, the mackarel, the cod-fish, the haddock, the turbot, the flounder, etc. On the other hand, there *are true bone corpuscles* in the skeletons of the minnow, the dace, the eel, the conger, the salmon, the trout, the herring, the anchovy, etc. Whatever may be attempted hereafter, we can at present found no systematic arrangement on this differentialism of structure. A vista, indeed, is opening, but a great clearance remains to be effected. The microscope is only beginning to let in the light. Perhaps our reader is wearied with this scientific note—again return we to the river.

Sequestered is the nook, or scooped out little bay, which memory paints truthfully before our inward vision. It is such a nook as would have delighted old Izaak Walton. It is plentifully stocked with chub, perch, roach, dace, and bleak. The loach (*Gobitis barbatula*) here lurks in deep holes, and the pike is taking his siesta on the borders of the opposite reed-bed. How often have we sat down on the bank, and watched the tenants of this aquarium. It is fringed with water plants, and the white and the yellow lily spread their leaves, repulsive of wet, in expansive beds. Watercress almost chokes up a little drainage-course which, traversing the meadows, pays its tribute to the river. We have here watched the actions of many a mollusc. We have seen the fluviatile mussel (two genera, *Unis* and *Anodon*) raise itself up on its edge, partially opening its valves, and traverse the mud, by a succession of impulsive movements, by no means so slowly as might be imagined; on the contrary, at a good round pace, as if restless, and, perhaps, hurrying to some attractive feeding-bed. Here, in security, the *Planorbis* floats like a curled-up boat; the *Physa* creeps over the under surface of water-weeds; the delicate *Limnæa* may be seen, sometimes floating, sometimes creeping up the stems that tower above the surface; and where the little rivulet joins the main water, the limpit-like *Ancylus* is to be found adherent to jutting stones, and generally to their under surface, as if preferring obscurity to a stronger light.

Such is the cove or nook which we attempt to picture. Here throng legions of aquatic insects; some creeping about like the feline prowlers upon land. Others, weaving their mazy dance on the surface, rejoicing in the warm sunbeams. How multitudinous the shoal of small, silver, gleaming fishes, which wheel around, now darting onwards, now returning, as if under some marshal of the host. They seem to be merry-making; they glisten as they pass, unheeding danger. They trifle on the verge of destruction. Let them beware—the perch is watching them, the trout is intent upon their movements, and the fierce pike is lurking close by, under cover of the reeds. A sudden splash! some pike or trout has rushed upon them—they are scattered in disorder—they dart to and fro—terror has seized the glittering host. But soon all is forgotten; they again coalesce, and wheel about as heedless as before. It is the brilliant little minnow (*Leuciscus phoxinus*, Cuvier) of which we are speaking, called in some counties the *pink* or *penk*. This active fish, seldom exceeding three or three and a-half inches in length, excels the gold-fish in beauty; but (perhaps from its restlessness) is difficult to keep in small aquatic vivaria: it seems to suffer from restriction, and we have seen it leap upwards of a foot out of a large glass-vessel, falling at a considerable distance on the floor.

There is a curious circumstance regarding the habits of this energetic little tenant of our rivers, to which Mr. Yarrell alludes, and which we have observed, we may say, a hundred times:—often may a congregated multitude be seen in clear water, forming a circle, their heads converging to a central point, and lower than the tails, so that the assemblage presents the appearance of a large flower, composed of multitudinous narrow petals, all still and quiet. The object forming the nucleus of this flower of fish-petals, we have always found to be some delicacy far too large to swallow, but affording excellent picking—usually a bit of animal flesh; and on one occasion, as we ascertained, it was the trifling fragment of a "meaty" bone, from the table, thrown into the water among other similar *rejectamenta*. Small as this minnow is, it is nevertheless a great delicacy; and, when numbers are procurable (as they may often be by means of a finely-meshed net), it makes a fry not far inferior to that of whitebait. W. C. L. Martin.

PLASTER MEDALLIONS IN IMITATION OF WAX.

At the invitation of Mr. Noteworthy, I herewith submit to the readers of Recreative Science an account of my method of manipulating medallions in imitation of wax.

Particular care in choosing the casts should be taken. Select those that are free from air-bubbles, which appear as little holes on the surface, generally in some prominent part. It is only by practice that these can readily be distinguished, but after a short time, the eye will naturally detect these defects.

Supposing a medallion about four or five inches in diameter is intended to be copied, of which the relief and the ground are to be of different colours, by which some very pleasing effects can be produced, the first operation is to take a cast or mould of it, for which, and subsequent purposes, the following simple apparatus will be found extremely useful, viz., a small gas-stove, made by bending a piece of sheet copper into a cylindrical form, about eight inches in diameter; a ring of iron tubing of about one-eighth of an inch bore, and three inches in diameter, to act as burner, by filing small holes in it at regular distances; two or three tops to this stove with different-sized apertures; a blocked-tin tray, about one inch deep, and nine inches square; an earthen pipkin; some stout cartridge-paper; two or three lipped white basins, and bone spoons; strong goat's-hair pencils.

With regard to the several compositions used, I prefer for moulds the following: white wax, four ounces (wax candle ends do very well, and are much cheaper); flake white, quarter of an ounce; melt together two or three times before using; wind a strip of cartridge-paper twice round the edge of the medal, and let it rise about three-quarters of an inch above the highest part of the surface; fasten the end with sealing-wax; then melt as much wax composition as will fill it to the top; next place some water about a quarter of an inch deep in the tin tray over the stove; when boiling, lay the cast in face upwards, and watch it until the water has risen through the medallion all over the surface. Then throw away the water, replace the tin tray with the cast in it over the stove again, and in about a minute pour on the wax, which should only be warm enough to keep it in a fluid state; immediately this is done, turn out the gas. After an hour has elapsed, the rim of cartridge-paper must be removed, for if allowed to remain on, the chances are the mould will crack owing to the wax contracting and sticking to the paper. In about ten or twelve hours you will be able to *lift* the mould from the medallion, when, if the process has been carefully executed, success is certain. During my repeated productions, I do not remember ever having had a failure.

The next process is to take a cast from the mould. First put a rim round it of cartridge-paper, as at first, but only about a quarter of an inch above the mould; put some water into a clean basin, and sprinkle into it as much *superfine* plaster as will, in your judgment, about fill up the sunk parts of the mould, care being taken to mix enough, it being impossible to again mix up plaster after it has once set. Pour away the supernatant water, and that remaining will be the exact quantity required to mix the plaster into the consistence of cream; put a small quantity into the hollows of the mould, and well brush it into every cavity with a rather stiff goat's-hair brush; then carefully pour in more until the hollows are filled; tap the bottom of the mould on the table that any air-bubbles remaining may rise; immediately mix up more plaster in another basin with the colouring matter chosen, say yellow ochre if a yellow tint is required, about four shades darker than you wish it to be when finished; and pour on as before, carefully using the brush all round the edges, but not bearing too hard on the plaster already used; in about an hour the rim may be taken off. Let the cast remain for twelve hours, or more, when it will be found to have quite separated itself from the mould; trim the edges with a knife, and place it over the stove to dry, with a very small amount of heat, or, if in no hurry, on a mantel-piece, with the face to the wall, for two or three days, when it will be found to be thoroughly dried.

Should a polished surface be wished, take white wax one ounce, stearine four ounces, best clarified mutton suet half an ounce; put all into the tin tray, and apply a gentle heat until melted; place the medallion in it, face upwards, on two small pieces of wood, to prevent it from discolouring, and also to raise it high enough to prevent the composition flowing over the face; keep up a very gentle heat—in fact, only enough to keep it melted—until it appears to have risen *through* the plaster, and appeared over the whole of the medallion, in the same way that the water did in the case of the plaster cast; then take it out and place it on thick blotting-paper for a minute or two; remove it and put away until quite cold and *hard*, which will be in about twelve hours, when the process may be completed by gentle rubbing with cotton wool.

By attention to the above few simple instructions, any one cannot fail to produce pleasing and really beautiful copies of any work of art which may, by its value, etc., be out of their reach. With regard to the colouring matter used, that, of course, is left to the choice and taste of the manipulator; but it is considerably better to mix it with the plaster before casting in the way already described, than to attempt to lay it on after, it being impossible, in the latter case, to insure any even tint.

Should any casts already taken be desired to be coloured, the only colour at all satisfactory to me is a bronze green, produced by Indian ink, Indian yellow, and indigo; when dry, pass the stearine composition through it, and when cold and hard, polish with cotton wool, and the least quantity of plumbago. In colouring plaster, it should be borne in mind, that Prussian blue must not be used, as the colour becomes decomposed by the action of the plaster; for blues, smalt or indigo is best.

In offering to the perusal of your readers these few hints on the subject of casting plaster, I do so from the hope that in the practice they will derive as much pleasure as I have done; not only to themselves but to their friends, to whom, at a trivial cost, they can supply these elegant works of art, though their value may only be reckoned by the esteem in which the donors are held.

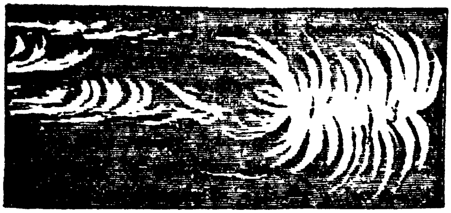
ALBERT GRAVES.

[The specimen sent with the above reflects the highest credit on the author's skill, and sufficiently proves the value of his instructions.—ED. R. S.]

THE LIFE OF A CLOUD.

"THE life of a cloud?" I fancy I hear you saying; "does a cloud live?" No, this is a figure of speech, and yet it is a figure that is not very far from the reality. Clouds, though they do not *live*, yet go through a period of birth, growth, maturity, and dissolution. I will show you how.

Come with me, on a bright summer's day, to some fine out-look—say, perhaps, Dover Cliffs, overlooking the bright sea. We will suppose a calm and almost cloudless sky—an expanse of blue empyrean. The warm air can sustain in solution all the vapour it contains, and consequently there is no cloud. This vapour may be a good deal in quantity; the hot sun may have played on the ground for a day or two, drying it up and carrying its moisture into the firmament above. Now let us suppose, while we are watching the



Cirrus.

a gentle air steals in from the sea—a gentle current of air that has been resting on the water, and is consequently much cooler than the air over our heads, which has been warmed by contact with the heated earth. Mark the result.

The air over our heads is gently cooled. It had as much moisture in it as it could dissolve when warm; but it cannot hold so much

Cirro cumulus.

when its temperature is lower. It is obliged to part with the excess—that is, it deposits it as vapour, being no longer able to retain it in the invisible form. A fine, delicate, filmy vapour appears, floating in the atmosphere, called by meteorologists, "cirrus." This is the *birth* of cloud.

The same can be witnessed on many a calm summer evening. The chill of night coming on will cool the air, so that it is obliged to part with some of the moisture it has sucked up from the earth during the sunshine of the day. Within half an hour the surface of the sky will change from clear blue to feathery clouds—not from fresh clouds coming from a distance, but from their birth, *in situ*, by the

Cirro stratus.

cooling of the air. It is evident that only when the air is nearly calm can this beautiful growth, apparently a creation out of nothing, be observed.

Our infant cloud, whose birth we have witnessed, has a precarious tenure of existence. A warm current of air setting in, or

Cumulus.

the rays of a warm sun, may at any time bring on dissolution, by enabling the air to take it up and convert it from *visible* vapour to *invisible* moisture. Its outward form is gone, and although we know its essence subsists still, and indeed can never be destroyed, yet its apparent existence has ended. Its short life has "made but one blot with infants."

It has vanished at the very outset of its career, before the purposes for which it was intended are accomplished; and, like the infant, too, it is only the outward form that sustains annihilation; its deeper essence is untouched by death.

Let us suppose our infant-cloud to survive the perils of early life, what changes does it undergo? There is no standing still in life; and this applies as much to cloud-life as to that of poor humanity. Escaped the dangers of too much warmth, it is next exposed to the winds and currents of heaven. If these are gentle, they only slightly modify the "cirrus," producing some of its beautiful varieties, the mare's-tail, the pilchard-sky, and mackarel-sky, so loved by the fishermen. These may be compared with the beauty of youth, before the full bloom of adult life is developed in its maturity.

But if the currents be long continued, or the winds be strong, a much greater change takes place. The feathery fragments, carried along the sky, hurled one against the other, become packed into large dense masses. Perhaps some attraction goes on among their particles. However that be, they take on quite a different aspect; instead of faint light cobwebs, floating high in the atmosphere, they become weighty aggregations of vapour, compelled to rest nearer the earth, where the atmosphere is dense enough to sustain them. Their density, too, is shown by the fine bold reflection they give of sunlight or daylight; and hence they are the painter's clouds, and form half the beauty of landscape. This is "cumulus," or cloud in its maturity.

Even now they are subject to that debility which springs from a life of ease and fortune. If the wind subsides, and they are left at rest, if the sun breaks out and pours his full rays on their rocky sides, what do we observe? Their surface becomes flaky. They are melting away under the influence of prosperity. Their visible moisture is again vanishing into the invisible form in which it existed before birth. If the "cumulus" be small and broken, it may succumb to these influences and altogether disappear; if large, although it may be weakened for the time, yet when the warmth passes away, it will recruit its force and be prepared to go forward with its mission.

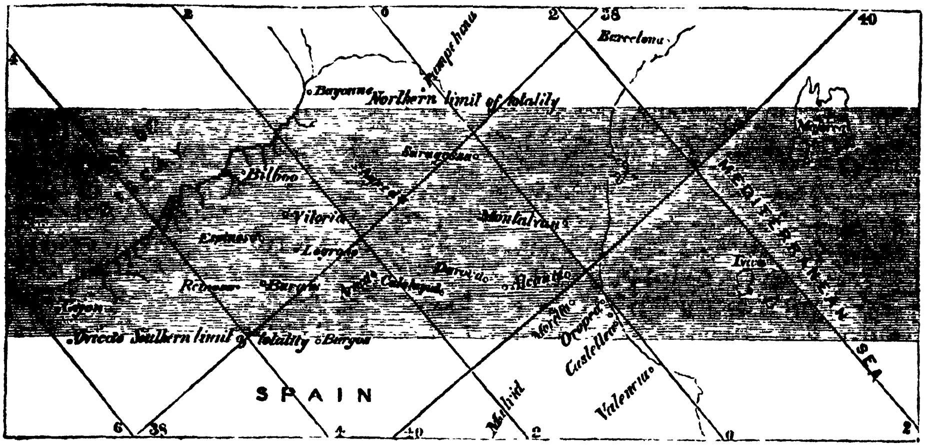
And now we come to the end. Our adult cloud has its mission to accomplish; and that is something more than furnishing picturesque objects for Turner to paint and Ruskin to write about. It has to carry the moisture gathered from distant parts to regions where it is needed. It may be long in the passage. It may be transported hither and thither by various winds, before an opportunity arrives; all this while it is probably gaining in close aggregation, the effect of wind being to pack its particles closer and closer together. At length a change takes place; it is approaching the end of its career. Some internal action pervades its molecules, perhaps an electric current runs through the mass; it becomes that dark, lowering cloud, which we call "nimbus;" the moisture is condensed into water, and descends in grateful showers to fertilize the soil.

The cloud is dead. The moisture which was its essence, which the warm air took up in an invisible form, which the cool air rendered visible, which the winds of heaven sported with, has returned to the earth from which it sprang. Or rather, it has come from distant seas and tropical climes, and been showered on more thirsty lands. While I write it is winter, and the rain-drops pattering against my window may consist of moisture pumped up in the Gulf of Mexico, by a broiling sun, last summer. Evaporation now going on, under the tropic of Capricorn, is feeding clouds which will go through their usual career, cross seas and continents, break against some mountain barrier, and fertilise plains and valleys. So excellent are the uses of these "water-bearers" of Nature.

Have I not shown you there is a "life"

in the cloud? We can witness its birth, we can observe it in its maturity, and we know it when dying and extinct. Think of this when summer brings her sunny days, her leisure, and the charming seaside life. There is a chapter of biography in the changing aspects of the sky.

Stoke Newington. J. J. Fox.



TOTAL ECLIPSE OF JULY 18, 1860.

THE eclipse of the 18th of next month is too important not to warrant a short space being devoted to it, and as those who intend to visit the line of totality require a certain amount of preparation before doing so, any particulars given in July would be too late to be of service, because, if the destiny should be Spain (which is the easiest of access), the frontier would require to be crossed at least a fortnight before the day of eclipse; for it must be recollected, that travelling is difficult in Spain, and more especially so in the middle of summer, when every one is flying away from the burning heat of the interior, to the more genial climate of the coast.

From Fig. 1 it will be seen that the central line (or line of totality) passes across the north Atlantic Ocean, west of Greenland, approaches Ireland nearer than England, entering Spain about midway between Gijon and Santandar, passing close to Reinosa, Arnedo, Calatayud, Daroca, Montalvan, Morella, and Oropesa, entering the Mediterranean at the latter-named place; crossing the island of Iviza, and passing into Algeria between Bugia and Algiers (not far north of Vingut), and terminating at the Red Sea.

The breadth of totality of the coming eclipse, will be very considerably larger than in the eclipse of March, 1858. In that eclipse it was said to be limited to four miles on each side the central line, though there is reason to believe it was more extended than this; however, on the 18th of July it will be ten times greater than in that of the eclipse of 1858. Indeed the southern limit of totality in Spain extends considerably beyond Oviedo and Valencia, whilst the northern limit nearly

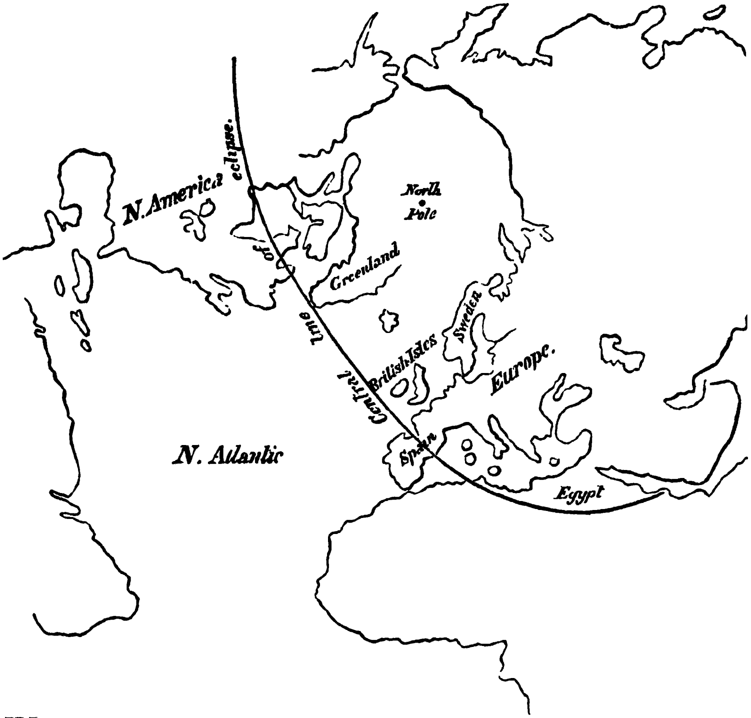


FIG. 2.

reaches Pampeluna, and extends beyond Tortosa, crossing the island of Majorca a little south of Palma. In Algeria, Algiers is some distance within the southern line of totality.

Confining ourselves for the moment to the eclipse of July 18, the middle of the eclipse, at Greenwich meantime, will be at Gijon at 2h. 58m., at Santander 3h. 0m., at Vittoria 3h. 2¼m., at Almazan 3h. 5m., at Calatayud 3h. 6m., at Morella and Tortosa about 3h. 9m., and at Castellon and Oropesa about 3h. 10m. The time of greatest darkness occupied, on the central line, crossing Spain, will be 10½m. The island of Ivica and the town of Palma (in Majorca) will have the middle of the eclipse at 3h. 13m., whilst at Vingut (in Algeria) it will be at 3h. 19m.

The duration of totality on the central line on entering Spain (in the Bay of Biscay) will be 3m. 35s., at Calatayud 3m. 30⅓s., and at Oropesa 3m. 27s., and at Vingut (in Algeria) 3m. 18⅓s.

Fig. 1 represents the central path and the limits of totality across Spain.

In England the eclipse, although a large one, will only be partial. It will in London begin at 1h. 38m. p.m., and end at 3h. 53m. p.m., the greatest darkness being at 2h. 48m. p.m. In Edinburgh it commences at 1h. 16m. p.m., and ends at 3h. 30m. p.m., the greatest darkness occurring at 2h. 25m. p.m.; and in Dublin it commences at 1h. 2m. p.m., and ends at 3h. 21m. p.m., the greatest darkness being at 2h. 14m. p.m.

Supposing the sun's disc to be represented by 1000, then the amount eclipsed at Greenwich will be 830, at Cambridge 817, at Ox-

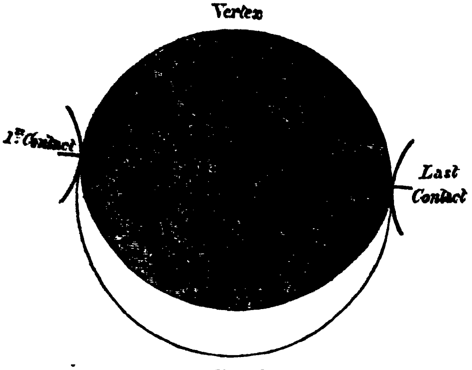


FIG. 3.

ford 840, at Liverpool 830, at Edinburgh 788, and at Dublin 866.

To those persons going into Africa it is

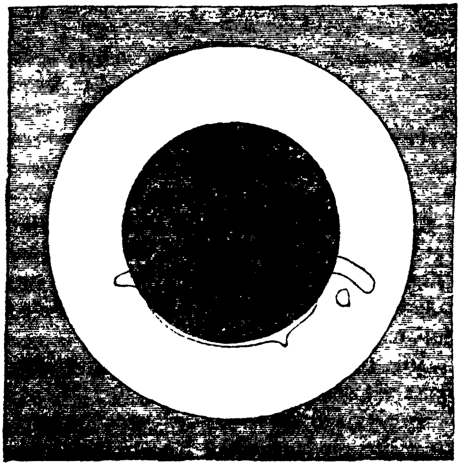


FIG. 4.

desirable to mention that the eclipse is total at Algiers, Bezan, Tozer, Sockna, Sebba, Goddona, and Mourzuk.

The appearance at Greenwich will be as represented in Fig. 3, whilst such phenomena as those shown in Figs. 4 and 5 may be expected on the central line. The prominences on Fig. 4 are *red flames*, so well seen in 1851, and which will again, no doubt, be visible

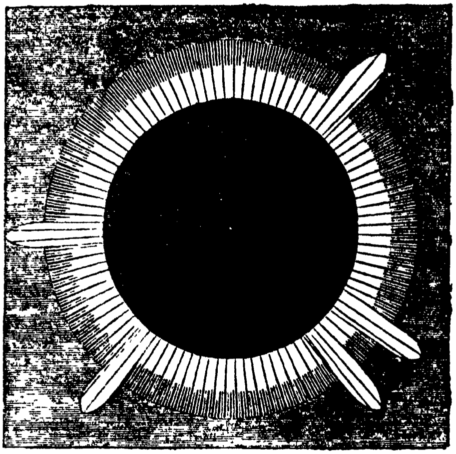


FIG. 5.

in Spain and Africa on the 18th of July next. The corona of light which surrounds a total eclipse is a most imposing and never-to-be-forgotten sight, also shown in Figs. 4 and 5.

Eclipses of the sun may be *partial, i.e.*, the dark body of the moon may only cover a portion of the solar disc, or *total* when the moon entirely covers the whole body of the sun, or *annular* when the sun's apparent diameter exceeds that of the moon, in which case the moon, although passing centrally between the sun and the earth, is not large enough to hide the whole of it, and therefore the outer edge of the sun remains visible as an *annulus*.

The grandeur of a total eclipse, and the awe which strikes every one during its continuance, is of that remarkable nature that if once seen can never be forgotten. As the eclipse progresses, the diminution of light is not apparent, until a considerable portion is eclipsed; after four-fifths of the sun is hid, the loss of light is every instant more perceptible, and as the last trace of the sun disappears, darkness *instantaneously* supervenes and the stars become visible. If the situation from which the eclipse is observed is one which commands a good distant view, the shadow caused by the sun becoming total in the distance first, is a striking phenomenon, as this shadow is distinctly seen travelling along towards the observer, till at length it envelopes him in its darkness. Total eclipses of the sun are by no means as common as are generally supposed, being very limited in their extent, so that it is a great chance against one occurring on a small island like Great Britain. According to Mr. Hind, the next visible in England will take place on the 19th of August, 1887, although there will be large ones in 1867 and 1870.

As the period of totality approaches, the small remaining illuminated disc of the sun changes colour, either becoming paler or redder, and flashes of light are occasionally noticed on the moon's disc, while luminous appearances of a more permanent character are seen on her surface, either as a narrow stream of light or a bright speck, and often the visible edge of the moon has been seen projected beyond the sun's cusps. In the eclipse of July 7, 1842, the thin crescent of light was observed to change suddenly to a line of *luminous points*, seeming to be wafted from the extremities to the centre of the crescent.

Occasionally the lunar disc is dimly illuminated, and this is termed the *lumière cendrée*, and appears to be the light of the sun reflected on our globe, re-reflected from the earth to the moon, and finally back again from the moon to the earth.

The most striking feature is a ring of light encircling the dark body of the moon and called the *corona*, or *glory*, which varies considerably in its appearance, as viewed in different eclipses, and in different places of the same eclipse; in some instances the intensity of the light was almost too dazzling to look at, whilst in others there was not this great brilliancy. Usually the corona is formed a few seconds before, and lasts a few seconds after, totality.

Another striking feature must be mentioned, viz., the rose-coloured prominences or flames situated on various portions of the moon's limb whilst the sun is totally eclipsed, and these are visible to the naked eye.

The determination of the precise time of the first contact of the sun and moon is of much importanee, as this enables the longitude of the place to be accurately calculated.

The aspect that Nature puts on is remarkable. The distant prospect becomes contracted considerably, the sky assumes various colours, the landscape has an unnatural, gloomy look, whilst the darkness is totally different from that of night. Everything appears to change its colour and appearance. In the animal kingdom cattle return home or congregate together in the fields; horses in vehicles have been recorded to have remained motionless, and could not be induced to stir; dogs howl, fowls return to roost, bees return to their hives, birds cease singing, and rooks fly back to their rookeries, animals and birds being evidently terrified, and conceive that night has suddenly returned upon them. On the reappearance of the sun the birds resume their songs, and cocks crow incessantly as in early morning. During the eclipse of March, 1858, I witnessed, on the central line of eclipse at Isham—the position which I selected for observing this eclipse from—rooks returning in pairs, one after the other, and on the increase of light, those that had not reached the rookery were seen to turn round abruptly in the air and retrace their flight to the fields they had previously left. The telegraph posts on the railway were not visible at the distance of a quarter of a mile; whitewashed houses had a decidedly warm yellow look, and the people, who were congregated together in great numbers, did not speak a single word, a death-like stillness prevailing. Crocuses closed their blooms, the air became colder and more humid, and the wind, which was blowing briskly, became almost motionless. To ascertain the direction of the wind I had taken a light, silk flag, which was flying at full length until the time of greatest obscuration, when it was observed to be lying close to the flag-pole.' Many of these particulars were further verified, in the neighbourhood of the Highfield House Observatory, by those whom I had left in charge. Flowers closed, turkeys ran home from the fields, fowls went to roost, peacocks flew into the trees, cows came to the gates of the field awaiting to be fetched home, and ducks wandered about the grass in search of snails as they do at dusk hour, whilst hares rose from their forms. A person ploughing could not see the end of the furrow 100 yards off, and another who had tried ineffectually to light his pipe with a common match on account of the strength of the wind, said that at the time of greatest darkness he had not the slightest difficulty. A fox-hunter described that he was hunting, and the scent very good until the centre of the eclipse, when all scent vanished and the sport had to be relinquished.

In the eclipse of 1858, at the time of greatest obscuration the darkness was not felt to be nearly as great as was expected, especially to those who had no means of testing it accurately, and the reason of this is very easily explained. The sky was overcast, consequently the pupil of the eye was much dilated, and therefore enabled to take in on a much larger surface what small amount of light remained; and it must be borne in mind that this was an annular eclipse. Had the sky been cloudless, the pupil would have contracted, and the loss of light consequently rendered much *more perceptible*. As a practical proof that there was a considerable amount of darkness, the indices of some delicate thermometers could not be read without the aid of a lamp; and again, on a subsequent date, during a thunderstorm, when it was remarked by several persons that the darkness was greater than in the eclipse (and indeed it really appeared to be so), nevertheless the delicate instruments could be read without any difficulty.

Prior to the annular eclipse of the sun of March 15, 1858, the Astronomer Royal published some suggestions for observers, many of which will be useful on the approaching eclipse.

I.—OBSERVATIONS NOT REQUIRING INSTRUMENTS.

As the eclipse advances, estimate or measure the degrees of darkness: at what distance from the eye can a book or paper exhibiting type of different sizes be read.

If in an elevated position, remark the changes and colour of the surrounding objects in the landscape.

If the spots of light formed by the intersecting shadows of the boughs of trees be seen, remark whether they exhibit the luneform of the sun.

When the annulus is formed, which will probably be observed with a darkened glass, it is important to notice with the naked eye whether the annular sun appears as an annulus or a fully-illuminated disc.

II.—PHYSICAL OBSERVATIONS REQUIRING THE USE OF INSTRUMENTS.

As the eclipse advances, estimate the comparative intensity of sunlight near the centre of his disc and near his limb.

A low power to be used, in order to take into the field of the telescope the whole body of the sun.

Remark irregularities on the moon's limb.

As the cusps become very sharp, see whether they are irregular (a coloured glass to be used).

Notice if the sun's light extends beyond the intersection of the limbs of the sun and moon, so as to exhibit the moon's limb beyond that intersection.

Remark whether Baily's beads and strings are formed, and how they form and break;

also whether any red flames are seen on the sun's limb.

Measure with a sextant the intervals between the points of the bright cusps.

With a doubly-refracting prism make observations on the polarization of light from the sun's limb.

The British Meteorological Society recommended that the barometer should be occasionally read, the black bulb thermometer exposed to the sun's rays, and the wet and dry bulbs in shade, every five minutes, the observations to commence half an hour before and terminate half an hour after the eclipse; the state of the sky before, during, and after the eclipse to be recorded.

It is most desirable during the continuance of totality, to commit everything to memory and not to attempt to record anything until this portion of the eclipse is over, or many important points of observation will be lost.

Turning to eclipses generally, a remarkable relation subsists between the synodic revolution of the moon and the motion of the nodes, which causes the phenomena of eclipses to return within a definite period nearly in the same order. In fact, while 223 lunations include 6585·321 days, the nodes return to the same position, with respect to the sun, in 6585·772 days, the difference amounting to barely twelve hours. The period being eighteen years and ten or eleven days. The difference in these two periods, together with the inequalities both of the moon's longitude and of her node (the *mean* synodic revolution and the *mean* motion of her node only having been before considered), will cause the corresponding eclipses in each cycle to be of somewhat different magnitudes, and to occur more or less irregularly. We will take the example of 1842 and the present year, as they are the same eclipses recurring:—

(1.) 1842, January 11. Annular solar eclipse, the annular path crossing the sea and passing across the south pole. (Invisible at Greenwich.)

(2.) 1842, January 26. A partial lunar eclipse, visible at Greenwich. Magnitude of eclipse, 0·792.

(3.) 1842, July 7. A total solar eclipse, the central path from Gibraltar, across Europe and Asia, to the North Pacific Ocean.

Partial at Greenwich, magnitude . . . = 0·801
„ at Edinburgh „ . . . = 0·687
„ at Dublin „ . . . = 0·711

(4.) 1842, July 21. A partial lunar eclipse. (Invisible at Greenwich.)

(5.) 1842, Dec. 31. Annular solar eclipse, central line crossing the South Pacific Ocean, across the centre of South America to the North Atlantic Ocean. (Invisible at Greenwich.)

(1.) 1860, January 22. Annular solar eclipse, the annular path crossing the sea, and passing across the South Pole. (Invisible at Greenwich.)

(2.) 1860, February 6. A partial lunar eclipse visible at Greenwich. Magnitude of eclipse, 0·809.

(3.) 1860, July 18. A total solar eclipse, central path crossing North America, Spain (across the Bay of Biscay), through Egypt.

Partial at Greenwich, magnitude . . . = 0·830
„ at Edinburgh „ . . . = 0·788
„ at Dublin „ . . . = 0·866

(4.) 1860, August 1. A partial lunar eclipse. (Invisible at Greenwich.)

(5.) 1861, January 10. Annular solar eclipse, central line crossing the Indian Ocean, across Australia into the North Pacific Ocean. (Invisible at Greenwich.)

Out of seventy eclipses which usually take place in eighteen years, the mean number of the sun is forty-one, and of the moon twenty-nine. From this it would appear that solar eclipses are common, but owing to the moon's body being small, in comparison with that of the sun, a total eclipse is of rare occurrence, and, as it is limited in extent, the occurrence is much less frequent at one particular place. Halley remarked, in the total eclipse of 1715, May 3, which occurred in London, that previously none had occurred since 1140, March 20; indeed the region obscured by the moon's shadow usually does not exceed 180 miles in diameter.

A solar eclipse may last several hours, but the period of totality cannot exceed 7m. 58s. under the equator, and 6m. 10s. in the latitude of Paris, according to Du Sejour. An annular eclipse lasts longer, because the excess of the perigean diameter of the sun over the apogean diameter of the moon (3′ 13″) is greater than the excess of the perigean diameter of the moon over the apogean diameter of the sun, (2′ 1″), and also because the moon's motion over the solar disc is slower when in apogee than in perigee. Du Sejour gives the utmost limit under the equator of 12m. 24s., and in the latitude of Paris, 9m. 56s.

Eclipses (of the sun more especially) have excited the attention of all ages. We have not space to enter fully into them; let it suffice, therefore to state, that Herodotus describes the total eclipse which occurred whilst the Medes and Lydians were engaged in battle (in the year 480 A.C.) Thucydides alludes to another in 431 A.C. Diodorus Siculus of one on August 15, 310 A.C., and history makes mention of others in A.D. 96, 237, 360, 418, 484, 787, 842, 878, 957, 1113, 1140, 1187, 1241, 1415, 1433, 1485, 1506, 1530, 1544, 1560, 1567, 1598, 1605, 1652, 1699, 1706, 1715, 1724, 1733, 1766, 1778, 1806, 1834, 1842. Of annular eclipses no mention is made until 1567, others being described in 1601, 1639, 1737, 1748, 1764, 1791, 1820, 1831, 1836, 1838, 1847, and 1858.

On the reappearance of the sun, the suddenness with which day succeeds night is a striking phenomenon, being compared by observers to that of the swiftness of an arrow, or even of a flash of lightning. The difference being striking between that of the disappearance of the sun, and that of the reappearance, the former being more gradual. Mr. Grant says, with great truth, that it is owing to the different dimensions of the pupil of the eye at the commencement and end of a total obscuration. During the period of darkness the pupil has expanded, and on the sudden reappearance of light, there is a larger surface available to see it with. The luminous ring to which we have before alluded, appeared with great splendour during the eclipse of July 8th, 1842; varying in breadth at different stations, from 3′ to that of 25′; from this ring issued expansions of light, in some instances extending 4° from the moon's limb. The conceived notion of this ring is, that it arises from the presence of a solar atmosphere.

With respect to localities favourable for observation in the coming eclipse of July 18, turning to the north-west portion of the shadow-path in Spain, a mountain chain, known as the "Cantabrian Pyrenees," or, "the mountains of Asturias," lie parallel to the north coast of Spain, at a distance of forty or fifty miles from it. These mountains rise to a considerable height; in fact, the lowest gaps which could be found for railways going south from Bilbao and Santander, are 2500 feet high. Between these mountains and the coast there are said to be sometimes fogs, but that higher up, at not less than 5000 feet, there is every probability of clear sky: such situations may be found near Orduna and Reinosa. From these mountains others proceed in a south-east direction, bounding the valley of the Ebro, the mountain-chain on the south-west side of which valley is nearly on the centre of the eclipse. This chain, after running a considerable distance, is suddenly cut off by the valley of the Xalon, and it here turns sharply in a south-west direction, where the lofty mountain Moncayo is situated (in the hollow of which rise the streams of the Douro), a position possessing remarkable advantages for viewing the landscape during the eclipse; to this point M. Faye, with the French official expedition, and Don Antonio Aguilar, with a party of Spanish astronomers, have signified their intention of proceeding. Between this point and Reinosa there are many favourable positions, and amongst them the mountains of Pancorbo. To those who do not like experiencing the inconveniences of mountain travelling in a country presenting great difficulties to those leaving the highroad, one of the following towns might be selected: Vittoria, Miranda, Burgos, Bilbao, and Santander.

It seems probable that the Admiralty will send out a steamer for the conveyance of English astronomers, to be landed either at Bilbao or Santander, and fortunately, at the present time, a railway is being constructed from Bilbao, crossing the mountains to Orduna and turning down the valley of the Ebro to Miranda and Logrono; the whole of this district is occupied by English engineers and workmen, under the direction of Mr. C. Vignoles, C.E., Mr. Brassy, the contractor, and Mr. Bartlet, the sub-contractor; whilst a second railway is in progress from Santander, crossing the mountains by Reinosa, of which Mr. P. Sewell is engineer; those gentlemen have very handsomely offered every kind of convenience and hospitality. The Spanish Government, through Don Antonio Aguilar, director of the Madrid Observatory, has anticipated various difficulties to foreigners, and have signified to the Astronomer Royal that the instruments of the astronomers shall be admitted duty free, and that the local authorities shall afford effectual assistance and advice.

Lastly, the principal planets are well situated for observation, and it is to be hoped that the new stranger, Vulcan, may on this occasion be recognized.

Amongst other expeditions, Mr. Davidson, under the directions of Professor Bache, will command one near Astoria, at the mouth of the Columbia river (129° W. long. and 46° 20′ N. lat.), the central line being 10′ or 15′ further north, to which point the astronomers will proceed. Lieutenant Gilliss will take up a position at Cape Chudleigh (lat. 60° N. long. 65° W.) Observers of the Hudson's Bay Company are to be stationed near York Factory (lat. 56° 52′ N. long. 91° 8′ W.), and the French astronomers are to have a corps of observers in Algeria, as well as on the north-east coast of Spain. According to Dr. Mädler, the Campvey of the isle of Ivica (on the central line) is an elevated situation, which is likely to afford a magnificent spectacle of the passage of the shadow and the general phenomena of the eclipse.

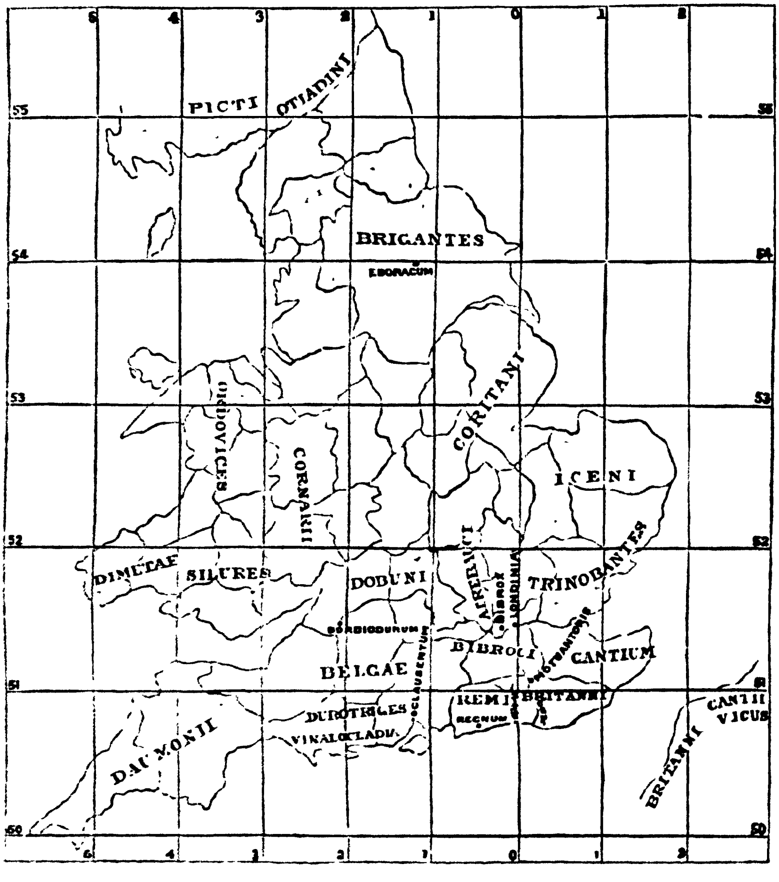
English observers cannot too much thank the Astronomer Royal for the great labour he has so willingly undertaken in their behalf, as regards every information that will be of importance to them; or Mr. Hind, who has published supplements, with maps for their guidance, of the "Nautical Almanack;" in short, the leading astronomers, Lord John Russell as Foreign Secretary, the Spanish Government, and the engineers now in Spain, have done everything in their power to forward the wishes of observers; and of the latter, Mr. Vignoles must be especially mentioned—indeed, he is making maps of the country on the Biscay side of Spain for the special use of astronomers.

E. J. Lowe.

THE EARLIEST COINAGE OF BRITAIN.

COINS OF THE ANEPEGRAPHIC PERIOD (OR THOSE WITHOUT INSCRIPTIONS).

The group of islands now known as Great Britain were originally peopled, like other parts of Europe, by successive bands of colonists. The first of these, of which any record remains, were the Cymri. These rude tribes, there can be little doubt, effected all their exchanges by means of simple barter. At a more recent but still remote period, the Cymri were followed by colonists from among the more civilized tribes occupying the opposite shores of Gaul, or Gael, the chief seat of the Gaelic or Celtic nations. These new colonists drove their predecessors from the coasts into the interior of the country; eventually forcing them backward into the far north or among the mountain recesses of Wales.* The new comers, though more advanced in general civilization, were still as ignorant of the use of coined money as the ruder people they displaced. But they were skilful miners, and knew the use of metals. Cæsar informs us, in speaking of the different tribes that peopled Gaul, that the Southern Gaels were especially skilful in mining, and we may thence infer that their more northern neighbours, from whose tribes the colonists of these islands proceeded, were, if not equally expert, at all events not ignorant of the art of conducting mining operations.



Taking this for granted, we may infer that it was by their skill and [illegible] the tin-mines of Cornwall were first worked with success. Their discovery of that metal in large quantities must soon have become

* These early inhabitants of the island afterwards called Britain, are possibly represented at the present day by the flint inst[illegible] in the bone caves at [illegible]orquay, and some other places. They were, in all probability, a savage and scanty race, whose civilization and small numbers could offer no effectual resistance to such invaders as the Celtic Gauls.

known on the Continent, and the tin exported thither in exchange for other products.

The Gallo-Celtic tribes who thus emigrated to the western island, whose white cliffs were visible from their own shores, brought along with them, not only their own continental names, but those also of their cities, and even the streams upon which they were situated. Just as in recent times we find English colonists founding a "New England," and cities named York, and Halifax, and London, in the wilds of North America, and in our own day a New South Wales on the shores of Australia; so the Gallic tribes, known as the Attrebates, the Reni, the Bellovaces, the Britanni, the Cantii, founded colonies on the island opposite their shores, in which each tribe still bore the name of its parent in Gaul. Thus, the Cantii gave their name, as Cantium, to the region they occupied—a name still preserved in the modern "Kent;" and the Britanni, an insignificant tribe, not even mentioned by Cæsar, yet not overlooked by the indefatigable Pliny, so throve and multiplied in their new home, that they eventually conferred their name upon the whole island, which became Britannia, or the land of the Britanni. On the south coast, the river Ouse still bears in its name a proof that the tribes who settled there came from the banks of the Gallic *Oise;* and the Adour and other streams bear names that might equally be traced to a Gallic original. There seems some reason to believe, that for a considerable time after the settlement of Gallic tribes in England, they still owed their allegiance to the chiefs of their parent tribes in Gaul; and it is thought by some, as stated by the old chronicler Richard of Cirencester, that an offshoot of the warlike Senones, the leading tribe of Gaul, occupied an extensive region south of the Thames, from whence they were summoned by their continental chief, the celebrated Brennus, to join his well-known expedition to Italy, about six centuries before the Christian era. It is stated by the same authority, that a tribe of the Belgi landed on that occasion, and took possession of the deserted lands of the Senones.

It was probably about six hundred years before the Christian era that the Phœnicians, trading in metals and other products, and especially in tin, which was in so much request in the South of Europe as an ingredient in the composition of the celebrated bronze, ventured through the Straits of Gibraltar into the open ocean in search of this means of wealth at its principal source in the great western islands, known to the ancients as the Cassiterides. The trade then established by the Phœnicians was carried on by means of barter; in which, no doubt, the ignorant western miners were lightened of their wealth in the coveted tin by the cunning orientals in exchange for a few baubles, probably a few strings of glittering beads, just such as our own African merchants, in the seventeenth century, found sufficient to purchase from the inhabitants of Africa their precious gold dust.

About three hundred years later the Greek colonists of Marseilles followed the track of the Phœnicians, and became their rivals in the trade, and the native islanders, no doubt, benefitted by the rivalry to the extent of obtaining a few more strings of beads or a few more showy trinkets than before, in exchange for the product of their rich tin-mines. At that period, also, it is probable that they saw for the first time pieces of coined money, for the Greeks of Massilia had then known its use for full three hundred years. If, however, the tin-merchants of Cornwall obtained any of the coins which they must have seen in the possession of the Greeks, it was, perhaps, only as trinkets, and without any accurate knowledge of their precise value as a regulated medium of exchange. Nevertheless, although they may have been unacquainted with coined money, adjusted scrupulously to a certain weight and value, and passing by tale instead of weight, it appears probable that a metallic medium of exchange was not altogether unknown to them. The iron money, referred to at a later period, was possibly in use among them at a still earlier period than the one under discussion, as the character of the objects considered to have been used as money of this description bears the stamp of a very remote antiquity. They are thin iron plates, somewhat in the form of the early Chinese money, being square with a perforation in the centre (Fig. 1), by means of which bundles of them might be carried threaded on a thong or string. Several cart-loads of these singular plates, of different sizes, were found in Cornwall in 1694, as described by Mr. Edward Lloyd in his travels through Cornwall in the year 1700, of which some account is given in Gough's notes to his edition of "Camden." In 1730, another hoard of these iron plates was discovered in a wall on pulling down some very ancient buildings at Boconnoe, the seat of Lord Mohun; but in this latter case not more than a peck of them was found. In addition to this rude monetary medium, they may have had rings and other articles of gold and silver adjusted to certain weights, after the manner of the ring-money and jewel-money of the East. But that medium always passed by weight, and not by tale, or number, like true coins. About one hundred years later, the second punic war (218 B.C.) put an end to the Phœnician trade, leaving it entirely in the hands of the Massilian Greeks, who no doubt knew how to work it to their own advantage. The fast extending power of Rome, after the fall of Carthage, soon rendered the traffic by way of the Mediterranean Sea unsafe for the Greek merchant-vessels, and their trade was thenceforward carried on overland across the whole of Gaul. In consequence of this alteration in the channel of commerce, a great mart for the Cornish tin was established in the Isle of Wight, as being conveniently situated opposite to those ports of France through the medium of which the trade was carried on, and from which, as we learn from ancient authors, thirty days' journey was required to convey merchandise to the Rhone, and down that river to Massilia.

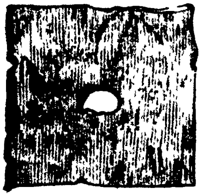


Fig. 1.

The transit trade thus established soon fell entirely into the hands of Gaulish merchants, who, as of kindred race with the inhabitants of Britain, no doubt traded upon fairer terms. It is, therefore, from this period, and probably not earlier than from 150 to 200 years before the Christian era, that money was first paid in exchange for their native tin and other national products. The Gauls of the south had learned, at a somewhat earlier epoch, the use of coined money. The celebrated gold staters, issued in such numbers by Philip of Macedon about 350 B.C., soon after his acquisition of the famous gold region of Thessaly, were rapidly spread over the whole of Southern Europe; and such was the esteem in which they were held, from the accuracy of their weight, the purity of their metal, and the beauty of their execution, that they rapidly became a fixed medium of exchange in countries where coined money had been previously unknown.

They were closely imitated in Italy, whose state of civilization provided artists equal to the task, and more rudely in others, where the skill of the die-sinker was an art still in its infancy. In Massilia, imitations were doubtless produced equal in beauty to the models from which they were copied; but the imitations attempted by the neighbouring Gallic tribes became ruder and more rude as they were more distant from the small focus of Greek civilization so long established at Massilia.

It was no doubt in rude Gallic imitations of these celebrated gold coins, known as "Philips," after the name of the prince who first issued them, that the Britons received their first actual money payments for their wares. Such, at all events, is a fair inference to be drawn from the fact that the first coined money of the natives of the British isles consisted of copies of these same "Philips," still ruder than the copies of the Gauls, of which they were probably still further debased imitations.

In order to make the excessive rudeness of the imitation clearly intelligible, it will be necessary to refer to the annexed engraving of one of the original coins (Fig. 2).

FIG. 2.

On the obverse is a finely-executed head of Apollo, with a conspicuous wreath of laurel, fastened at the back with a fillet. These last-named features will be found in a singularly conspicuous form in the copies about to be described. The obverse is without description, but the reverse has the name of Philip as ΦΙΛΙΠΠΟΥ, in the genitive case, beneath the device of the biga, or two-horse chariot, which, it is said, was adopted by that prince in reference to his victories in the chariot races of the Olympic Games. The features of this device become singularly distorted in the barbaric copies of Gaul and Britain, the first of which I am about to describe.*

The British copies of these coins, which were, no doubt, produced very soon after they had learned their use and value from their Gallic neighbours, were, like the Gaulish copies, without the Greek inscription. These rude copies of the "Philips" being, therefore, entirely without inscription, and remaining so till after the British intercourse with the Romans commenced, are classed by numismatists as the British coins of the anepegraphic period. It would occupy too much space to illustrate every degree by which the fine head of Apollo was reduced to a mere unintelligible mass of unmeaning forms in their rude British copies. I must therefore leave it to be supposed that the finest and best copies only very slightly resembled a human head, and then proceed to describe one of the strangest of the distortions eventually arrived at, which is engraved below (Fig. 3).

FIG. 3.

In these abortive copies the laurel-wreath appears to have been the feature that best retained some small share of its original character. In the present example, however, the leaves are made to turn the wrong way; and the fillet, by being placed at the middle, instead of the lower end of the wreath, was no doubt the first accidental hint that afterwards led to the formation of the wreath into a singular kind of rude ornament, somewhat in the form of a cross. The hair, so beautifully executed in the device of the original "Philip," is here only represented by a few crescent-shaped dashes, which in earlier and better specimens were rather better disposed, and had rather more resemblance to curling hair. The eye and eyebrow may be traced; and, with some stretch of the imagination, an intention to represent the profile of the nose, and of the mouth and chin, with an anterior dash to represent the nostril, may also be made out. The termination of the neck is also represented by a rude transverse line.

These rude traditional remains of a perhaps entirely forgotten original lost even-

* A foreign numismatist has published a series of the imitations of these celebrated "Philips," by different nations in different ages, showing every degree of degradation, from the nearly perfect copy to the most barbarous attempt at imitation.

tually all meaning, even to the "artists" who executed them; and in the next specimen (Fig. 4) we find the engraver endeavouring to give something of his own notion of symmetry to the seemingly unmeaning forms. It will not be difficult to trace, in the rude cruciform ornament forming the obverse of Figure 4, such a rearrangement of the forms of the preceding example. The single diagonal band of laurel is balanced by two transverse sprays; the fillet is made with a few additions of circles and dots to fill up the space between, and two of the crescent-formed locks of hair are placed back to back to form a central ornament. The later artist, seeing that an ornament only was required, executed one entirely after his own original design, and so we have, as shown in the annexed example (Fig. 5), the head of Apollo entirely replaced by a grotesque ornament, having no longer any connection whatever with the original design.

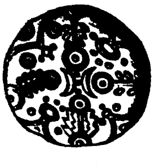


Fig. 4.

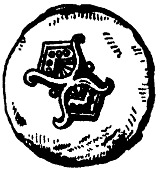


Fig. 5.

H. Noel

COLLECTING AND PRESERVING BIRDS' EGGS.

If I were asked, "In what object is the 'line of beauty' found which was first appreciated by, and charmed a child's heart?" I should answer—"In the form of a bird's egg;" and the reason for this may be readily perceived in a child's own sentiment—"Because a little bird makes the egg, and God made the little bird."

There are articles in daily household use which have partly a similar form, but there seems to be an intuitive perception in infant minds, that they are the work of mortal hands.

It matters not whether the egg-shell be full or empty, it is the gracefully rounded outline, the curious markings, the delicate tint, or the pure white, combined with its utter fragility, which causes it to be longed for, and carefully treasured up when possessed; but when, by holding it too tightly for fear it should fall, it breaks to pieces between the tiny fingers, the grief that is occasioned thereby leads those who witness it to reflect that "a thing of beauty is *not always* a joy for ever," but often a source of sorrow.

Many grown persons collect eggs, some because they are pretty, and form an amusing occupation to them during the leisure hours; others, because they are a help to the more complete knowledge of the history and economy of birds; and as one of these latter class, I offer these remarks.

With regard to their "structure," being composed, as they are well-known to be, of minute particles of carbonate of lime, united and strengthened by the addition of a small quantity of animal matter, it is no wonder that when blown they are so fragile, when we consider their thinness.

My first "collection" of sixty species (by the box containing it falling from the height of an ordinary table) became "smashed," with the solitary exception of one hedge-accentor's, over which I consoled myself as the "nucleus" of a future collection. Of this "special" egg more anon.

The "form" of eggs is somewhat varied; round, roundish-oval, elongate, larger at one end, equal at both ends, more or less pointed (sometimes at both ends), and pear-shaped; and all or any of these characters may apply to eggs of birds of the same species or class (with some exceptions), without including any "lusus naturæ" or unnatural form, such as bottle-shaped, spindle-shaped, narrowed in the middle, etc., etc.

Their "size" is variable also, but except in the case of unimpregnated eggs, not very much so; however, in almost every nest one egg occurs smaller than the rest, and separate birds of the same species lay eggs of very different sizes; as, for example, the chats, tits, and sparrows. This may depend greatly upon differences of food and locality, also upon the size of the birds themselves.

As to "colour," nothing is more variable; bluish, yellowish, brown, red, pink, and purple of various shades, as in the tree-pipit; blue, green, and brown, more or less deep, as in the gulls; red, yellow, white, brown and green, dull in tint, as in the common tern; white, red, or spotted, as in the robin; speckled, spotted, blotched, clouded, striped and zoned in many species; in fact, it is a matter of great difficulty to match specimens out of two different nests, except they are principally white, and then their relative size or shape often destroys the appearance of uniformity.

If form, size, and colour are thus so little to be depended upon, there is now only the "texture" on which any reliance can be placed, and this, in the case of imperfectly-shelled specimens, is rough, dull, and wanting in colour, when in a perfect egg it would be smooth, polished, and bright-coloured. This may be easily seen on comparing several specimens. Eggs of birds of the hawk tribe are strong-shelled, generally rounded, whitish, or blotched with dirty red, having a more or less *calcareous* surface. Owls' eggs are rather strong, mostly rounded, white, having a *chalky* appearance, although the surface has not the outer layer as in those of hawks. Those of the crow tribe have the shell thinner, more elongate, colours green or blue clouded with brown and gray, surface somewhat polished, but irregularly and *faintly wrinkled* all over. Those of the roller, kingfisher, and woodpecker tribe, thin, round, or pointed, white, *finely polished*, smooth and transparent when recent. Eggs of the insect-eaters, as butcher-birds, thrush tribe, warblers, etc., are so thin that the yolk may generally be seen through the shell of any fresh specimen; they are mostly elegant in form, colours varied, of reddish, yellowish, gray, brown, and blue in the shrikes and flycatchers—reddish, green, white, brown, blue, and yellowish in the warblers, their surface slightly polished. In those of the seed-eaters, as the larks, buntings, finches, and sparrows, the shell is slightly stouter, more robust in form, colours brown, gray, bluish or greenish white, spotted with dull red, purple, or black; more opaque (excepting the linnet tribe) and rather more polished. In the game birds the shells are tolerably stout, colour white, yellow, or brown, marbled and clouded with reddish or blackish; surface finely punctured, and much polished, those of pigeons glossy white, having similar characters of surface, but not so strongly defined. The eggs of the plover tribe are more or less pear-shaped, colours dull green, brown, or yellow, blotched with brown or black, surface dull, but rather smooth, and finely-grained. The eggs of gulls and terns are stronger, more rounded, colours dull red, brown, blue, green, yellowish, or whitish, clouded and spotted, or blotched with dusky, surface rough and unpolished. Of the ducks and geese the shells are strong, more elongate, colours uniform, white, or pale tinted brown, greenish or reddish yellow, surface dull, but very finely grained, appearing to be quite smooth. In those of grebes and cormorants there is a greater degree of strength in proportion to size; more elongate, somewhat pointed at both ends, colour bluish-green, with a thick outer chalky covering, like those of hawks, but not coloured. The diver's eggs are stout, elongate, approaching the pear-shaped, dark rich brown, blotched with black, surface wrinkled like those of the crow tribe. Those of the guillemots are very strong, generally pear-shaped and elongate, colour white, blue or green, blotched and striped with black and ash-colour, surface granular. Lastly, those of petrels are thin, roundish-oval, white or faintly zoned with pale red, surface dull but finely grained.

To preserve the shells of eggs, first take care to clear them of their contents; get a small, fine-pointed, common syringe, such as is sold in toy-shops for a penny or twopence, and inject the specimen with water until it comes out quite clean. When an egg has been partly hatched or addled, the removal of the contents generally includes that of the internal membrane or pellicle; this makes the shell weaker. When the specimens are quite clean internally, and have become dry (which will be in a day or two), take the syringe and inject them with a strong solution of isinglass (with a little sugar-candy added to prevent its cracking); blow this out again whilst warm. Let the shell get dry, and then wash the outside with a soft wet cloth to remove saline particles, dirt from the nest, etc. This method varnishes the inside, and the first specimen on which it has been tried was the before-mentioned hedge-accentor's eggs, which is to this day as bright in colour as a fresh specimen.

Also in a pair of nightjar's eggs, of which species the delicate gray tint is particularly evanescent, one was injected in the manner described, and the other was not; in the first the gray is still perfectly defined, in the other it has entirely disappeared. Eggs which have lost their internal pellicle become strengthened by this process, and those which have not lost their colour greatly improved.

HENRY J. BELLARS.

METEOROLOGY OF JUNE.

FROM OBSERVATIONS AT HIGHFIELD HOUSE OBSERVATORY.

Year.	Greatest Heat. Degrees.		Greatest Cold. Degrees.	Range of Temperature.	Amount of Rain. Inches.
1842	80·5	..	46·0	34·5	
1843	77·0	..	40·0	37·0	2·4
1844	86 0	..	44·0	42·0	1·6
1845	—	..	—	—	2·9
1846	91·0	..	48·0	43·0	1·7
1847	82 5	..	44·1	38·4	2·0
1848	82·5	..	40·1	42·4	4·7
1849	79·0	..	35·3	43·7	2·7
1850	87 2	..	35 1	52·1	1·4
1851	85 3	..	38 0	47·3	3·4
1852	77·0	..	39 7	37·3	4·9
1853	82·0	..	37·2	44·8	5·0
1854	79 0	..	41·0	38·0	1·0
1855	83 3	..	39·8	43·5	2·4
1856	84 2	..	39 1	45·1	1·5
1857	88·0	..	40·0	48·0	3·2
1858	92·2	..	39·5	52·7	1·3
1859	80·4	..	41·9	38 5	

The greatest heat in the shade reached 92·2° in 1858, and 91° in 1846, and only 77·0° in 1843 and 1852, and 79° in 1849 and 1854, giving a range of 15·2° in greatest heat for June during the past eighteen years. The temperature was very high in the years 1844, 1846, 1850, 1851, 1857, and 1858, being above 85° in all these years, whilst in 1842, 1843, 1849, 1852, 1854, and 1859, it did not exceed 80½°.

The greatest cold was as low as 35·1° in 1850, and 35·3° in 1849, and never below 48° in 1846, nor 46° in 1842, giving a range of 12·9° for greatest cold in June during the past eighteen years. The range of temperature was as much as 52·7° in 1858, and 52·1° in 1850, and as little as 34·5° in 1842, as 37° in 1843, and 37·3° in 1852, being a difference from the greatest to the least range of 18·2°.

In no year has less than an inch of rain fallen in June, the smallest amount being in 1854, when exactly one inch fell, whilst as much as 5 inches fell in 1853, 4 9 inches in 1852, and 4·7 inches in 1848, giving a range of 4 inches for June during the past seventeen years. In eleven years the amount exceeded two inches, and in six, three inches, the mean amount for June being 2·7 inches.

June may be considered the first hot month, the maximum and minimum temperature rising from 8° to 10° above that of May.

E. J. LOWE.

ASTRONOMICAL OBSERVATIONS FOR JUNE, 1860.

THE Sun is in the constellation of Gemini until the morning of the 21st, when he passes into that of Cancer. He reaches his most northerly declination on the 21st. He rises in London on the 1st at 3h. 50m. a.m., on the 9th to 12th at 3h. 45m., on the 18th to 21st at 3h. 44m., on 22nd to 24th at 3h. 45m., and on 30th at 3h. 48m. Throughout the month there is only a range of ten minutes in the time of his rising, and from the 9th to the 24th of only one minute. He sets in London on the 1st at 8h. 6m., on the 10th at 8h. 13m., from the 17th to the 20th at 8h. 18m., and from the 21st to the 28th at 8h. 19m., there being on the 21st 16h. 35m. of sunshine. He rises in Edinburgh on the 9th twenty-nine minutes, and on the 25th twenty-eight minutes earlier, and sets on the 10th to 26th twenty-eight minutes later than in London. He rises in Dublin on the 7th and 22nd eleven minutes earlier, and sets on the 8th ten minutes, and on the 23rd eleven minutes later than in London. On the 8th there is in Edinburgh 17h. 18m. of sunshine, and at Dublin on the 13th 16h. 53m. of sunshine.

The Sun reaches the meridian on the 10th at 11h. 59m. 9s.; on the 20th at 12h. 1m. 16s.; and on the 30th at 12h. 3m. 22s.

The equation of time on the 10th is 0m. 41s. after the Sun (*i. e.*, subtractive), on the 20th, 1m. 16s. before the Sun, and on the 30th, 3m. 22s. before the Sun (*i. e.*, addative).

Tthere is no real night in London.

The Moon is full on the 3rd at 4h. 46m. p.m.

New Moon on the 19th at 5h. 23m. a.m.

The Moon is at her greatest distance from the Earth on the 11th, and nearest to us on the 23rd.

Mercury is favourably situated for observation at the close of the month in the evening. He is in Taurus, passing into Gemini and Cancer. He is only about 1° north of Jupiter on the morning of the 29th, and is a morning star till the 6th. He rises on the 10th at 3h. 53m. a.m., on the 20th at 4h. 44m. a.m., and on the 30th at 5h. 41m.; setting on the 10th at 8h. 45m. p.m., on the 20th at 9h. 35m., and on the 30th at 9h. 43m. p.m.

Venus is a magnificent object, reaching her greatest brilliancy on the 11th, when she will be of the form of a fine crescent, and have an apparent diameter of 36″. She is in Gemini at the beginning, and in Cancer at the end of the month; rising on the 10th at 6h. 47m. a.m., on the 20th, at 6h. 37m, and on the 30th at 6h. 13m. a.m., and setting on the 10th at 10h. 59m. p.m., on the 20th at 10h. 21m., and on the 30th at 9h. 29m. p.m.

Mars is a bright object, but badly situated for observation on account of his nearness to the horizon. He is nearly stationary on the borders of Sagittarius and Capricornus. His apparent diameter on the 18th is 19″; rising on the 10th at 11h. 3m. p.m., on the 20th at 10h. 30m., and on the 30th at 9h. 53m. p.m.; setting on the 10th at 6h. 49m. a.m., on the 20th at 6h. 6m., and on the 30th at 5h. 16m. a.m.

Jupiter is an evening star, and is diminishing rapidly in brightness. He is in Cancer throughout the month. Rising on the 10th at 6h. 33m. a.m., on the 20th at 6h. 5m., and on the 30th at 5h. 37m. a.m.; setting on the 10th at 10h. 39m. p.m., on the 20th at 10h. 5m., and on the 30th at 9h. 35m. p.m.

Saturn is an evening star from the 6th, and situated in the constellation Leo, and, like Jupiter, is rapidly becoming a less conspicuous object. He rises on the 10th at 8h. 53m. a.m., on the 20th at 8h. 19m., and on the 30th at 7h. 46m. a.m.; setting on the 10th at 11h. 47m. p.m., on the 29th at 11h. 9m. p.m., and on the 30th at 10h. 32m. p.m.

Uranus is in Taurus, and invisible throughout the month.

Occultations of Stars by the Moon:—On the 2nd, star 5347 B.A.C., 5th magnitude, disappears at 9h. 40m. p.m., and reappears at 10h. 58m. p.m.; on the 16th ε Arietis, 4½ magnitude, disappears at 1h. 34m. a.m., and reappears at 2h. 25m. a.m.; on the 29th *b* Scorpii, 5th magnitude, disappears at 10h. 43m. p.m., and reappears at 11h. 48m. p.m.

Eclipses of Jupiter's Satellites:—On the 1st, at 11h. 4m. 39s. p.m., 2nd moon reappears. On the 2nd, at 8h. 34m. 54s. p.m., 1st moon reappears. On the 9th, at 10h. 30m. 7s. p.m., 1st moon reappears.

Difference of time between Greenwich and the other British observatories:—Cambridge, 24s. fast; Dublin, 25m. 22s. slow; Durham, 6m. 20s. slow; Edinburgh, 12m. 44s. slow; Liverpool, 12m. slow; Oxford, 5m. 3s. slow; Portsmouth, 4m. 24s. slow.

The variable star Algol (in Perseus).—This star is of the 2nd magnitude for 62 hours, then diminishes to the 4th magnitude in about 3 hours, remaining but a short time at this diminished size, and as rapidly recovers its usual appearance. The brilliancy at its maximum is almost five times as great as at its minimum. The times of *least light* (Greenwich time) during the evenings are June 5th, 12h. 41m., and June 28th, 11h. 11m. p.m.

E. J. Lowe.

THINGS OF THE SEASON—JUNE.

FOR VARIOUS LOCALITIES OF GREAT BRITAIN.

—o—

Birds Arriving and Departing.—None.

Insects.—Agonum sex-punctatum, Anomala Frishii, Atopa cervina, Adimonia Halensis, Balaninus nucom, Bruchus pisi, Callidium bajulum, alni, and violaceum, Cercopis sanguinolenta, Carabis arvensis, violaceus, glabratus, Cassida ferruginea, Coccinella oscellata, Calathus rufangulus, Calosoma inquisitor, Cleniocerus pectinicornis and æneus, Cionus verbasci and hortulanus, Cleonus sulcirostris, Clytus mysticus and arietis, Crioceris merdigera and cyanella, Chrysomela graminis and populi, Creophilus maxillosus, Donacia micans, Elaphrus cupreus, Elater sanguineus, Harpalus æneus, Hister bimaculatus, Hoplia argentea, Hylurgus piniperda, Hypera rumicis, Rhagium inquisitor and bifasciatum, Labia minor, Labidura gigantea, Leptura elongata and ruficornis, Malachius æneus and bipustulatus, Malthinus flavus, Monochamus sutor, Necrodes littoralis, Necrophorus humator, Patrobus rufipes, Platysma niger, Ptinus imperialis, Pyrochroa rubeus, Saperda ferrea and populnea, Serica brunnea, Silpha reticulata, Steropus madidus, Thanasimus formicarius, Tillus ambulans and unifasciatus, Trichius fasciatus nobilis and variabilis, Toxutus meridianus, Blister-fly, Musk-beetle, Stag-beetle, Dor-beetle, Great and Lesser Cockchafer, Glow-worm, Brimstone, Black-veined White, Small Tortoiseshell, White Plume, Yellow Underwing, Scarce Magpie, Currant Magpie, Pale-clouded Yellow, Dark Underwing Fritillary, Granville Fritillary, Comma, Marbled White, Ringlet, Marsh, Brown Argus, Meadow Brown, Five-spot Burnett, Green Forester, Poplar Hawk, Privet Hawk, Elephant Hawk, Currant Hawk, Burnished Brass, Wood Tiger, Scarlet Tiger, Hornet Moth, Gold Swift, Flame-tipped Redbelt, Buff-tip, White Satin, Great Egger, Cream Spot, Clouded Buff, Water Ermine.

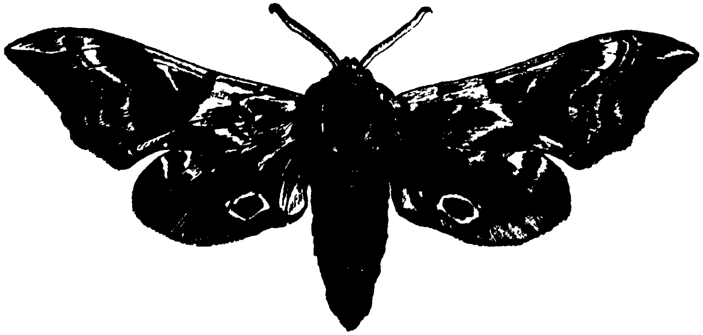
WILD PLANTS.—Brook Lime, Butterwort, Bladder Nut, Clary, Valerian, Club Rush, Small Scabious, Heath Bedstraw, Hoary Plantain, Burnet, Dogwood, Wall Pellitory, Ladies' Mantle, Forget-me-Not, Borage, Buglos, Buckbean, Water Violet, Pimpernel, Harebell, Deadly Nightshade, Woody Nightshade, Stemless Gentian, Shepherd's Needle, Hemlock, Carraway, Star of Bethlehem, Common Sorrel, Asphodel, Water Plantain, Willow Herb, Ling, Flowering Rush, Alpine and Mountain Saxifrage, Marsh Stitchwort, Sandwort, Ragged Robin, Corn Cockle, Awled Spurry, Agrimony, Meadow-sweet, Dew-berry, Cloud-berry, Cinquefoil species, Tormentil species, Dwarf Cistus, Columbine, Crowfoot species, Ivy-leafed Toad-flax, Broom-rape, Hedge-mustard, Crane's Bill species. Rest Harrow, Bird's-foot Trefoil, St. John's Wort, Hawkweed species, Plume and Carline Thistle, Ox-eye Daisy, Yarrow, Orchis species, Ladies' Slipper, Black Briony, Wood Spurge.

Mr. Noteworthy's Corner.

DO BEES MAKE HEXAGONAL CELLS?—Mr. Darwin, in his "Origin of Species," makes special reference to the researches and experiments of Mr. Tegetmeier on the mode in which bees work. It appears that we are altogether wrong in assigning to the bee a mathematical instinct, Mr. Tegetmeier insisting that integrally the cells are cylindrical, but become hexagonal only by the pressure resulting from their aggregation in the combs. In this view Mr. Darwin assents, and so far the elaborate arguments of Lord Brougham and others, who have written on the geometry of the bee-hive, come to nought. Mr. Noteworthy has seen circular cells in his own hives, and in samples of comb exhibited before the Apiarian Society, and his thought respecting the argument of design was this—the Creator has ordered it that the cylinder, which it must be easier for the bee to produce than the hexagon, shall become a hexagon in the natural course of events, and thus secure for the bee the geometrical advantages of six-sided cells, without entailing the trouble of their precise manufacture. The conversion of cylinders into uniform angular bodies shows the same working of a wise design for a good end, though by other methods than those we had previously recognized. For himself, Mr. Noteworthy would add that he does not consider the point as proven, but Mr. Tegetmeier's facts and inferences bear the stamp of genuine philosophy.

IS THE MOON HEATED BY THE SUN?—Many writers upon Astronomy, Sir J. Herschel amongst others, speculate upon the intensity of the solar heat upon the moon, during the fourteen days of uninterrupted sunshine which each portion of the lunar surface is successively exposed to. *Would any perceptible amount of heat from that source be felt there at all?* I know it is a disputed point as to whether there is any atmosphere there or not. I strongly believe there is none; but be this as it may, those even who support the opposite view, admit the *extreme* tenuity of the atmosphere they imagine. Now, if at a few miles from the earth's surface, even in the tropics, perpetual snow exists, and an intensity of cold in the broadest vertical sunshine, *simply because there* the air is less dense than at the surface, what must that cold be at ten times the elevation, where the air is very considerably rarer? Is not the existence of as dense an atmosphere as ours *essential* to the *perception* of solar heat, and if so—to return to my original question—would any solar heat at all be felt on the surface of our satellite? I know she reflects to us a minute amount of heat, but a polished reflector may do this without any being felt upon it. I have in vain endeavoured to get a satisfactory answer to this, and feeling greatly interested in the subject, I submit the question in hope of eliciting information.—A. L. S.

STUDIES OF ARACHNIDÆ.—Mr. Noteworthy is unable to refer his friend, who inquires for a work whereby to verify species of spiders, to any exactly adapted to the purpose. The articles under the several heads Epeira, etc., in the "English Cyclopædia of Natural History," will be found to contain the best general summary on spiders in the English language. Griffith's "Cuvier," and the new edition of the "Regne Animal," by his pupils, are good, but many discoveries and changes of classification have occurred since it was published. M. Walckenaer, in the portion of "Insectes apteres" devoted to them, is full and sound; as also Hahn and Kock's Die Arachnides, in sixteen volumes illustrated. Leuwenhoeck and Lyonet have some good detailed observations, probably Swammerdam and Spallanzani also. As to British spiders, there is no complete monograph. In the "Annals of Natural History" and the "Linnæan Society's Transactions" are numerous papers by Mr. John Blackwall, which are unequalled for accuracy. These, collected and revised, will form the staple of the text of the work upon them shortly to be published by the Ray Society, for which Mr. T. West, F.L.S., has been long engaged in making drawings.



Eyed Hawk Moth, on the Wing

NATURE'S PAINTING ON INSECTS' WINGS.

The beauty of the paintings on the wings of butterflies and moths has always been a source of great pleasure to me in its contemplation and study, and I have noticed, with others, that the colours and markings are arranged not only with a view of pleasing the eye, but also of deceiving it, where such artifice is rendered necessary by the habits of the creature. Let us take notice of a few remarkable instances of this.

And first it may be noticed, as a general rule, that the most brilliant colours and strongest contrasts are found on the upper sides of the wings, the painting of the under side being much more quiet and subdued. The object of this arrangement is clear; for when a butterfly is at rest, the under side is exposed to view. Now, if the brilliant colours were placed on this side, they would prove very attractive to the eyes of birds and other animals with any predilections for butterfly flesh, to say nothing of butterfly-hunting humanity. But as Nature teems with variety, and as every rule has its exceptions, so we find it here. Take, for an example, the little orange-tip, that looks like a white butterfly with red wafers stuck on the tips of his wings; not only do we find the red repeated on the under side, but also its complementary green in chequered markings on the white ground of the hind wings, and at the tips of the fore wings, thus producing a gay and pleasing effect. An object with such colours could not fail of being noticed if placed on a green leaf, or the bark of a tree, which are the resting-places of many species; but that marvellous gift of the Creator called instinct is here found working within for the safety of this little being. I will briefly state the simple facts, which, aided by the figures, will, I trust, be easily understood.

On a fine afternoon in May I took a walk in the country, and being overtaken by a shower, sought shelter under a hedge, where, among other flowers, that of the wild parsley was in the greatest profusion. While observing their light forms and pretty groups, I saw what appeared to be a small bunch of these flowers projecting a little from the rest. This proved to be an orange-tip butterfly at rest, and well did this little discovery make me amends for the trifling inconvenience of the shower. I noticed that the bright attractive orange colour near the tip of the fore wings was hidden beneath the hind wings. I also then perceived the end which is answered by having the tips of the fore wings on the under side coloured to match the hind wings (as above noticed)—a fact appertaining to most butterflies; it is, that the former project a little beyond the latter, and are consequently exposed to view in the position of rest. Referring to the figures, Fig. 1 represents the insect

FIG. 1.—Orange-tip awake.

displays all his beauties (the orange colour being indicated by the even shadow tint). Fig. 2 shows the same at rest on a wild

FIG. 2.—Orange-tip asleep

parsley blossom. It will be seen, by this figure, how well the chequered white of the hind wings represents the small white flowers against the dark green background of the hedge. I have frequently observed the creature at rest on this blossom, and occasionally on another small white flower, one of the *Cruciferæ*. It is more than probable that those foreign species, which have the under sides of their hind wings adorned with gay colours, find their resting-places on the ambrosial petals of similarly coloured flowers. Our own tortoiseshells, and other species of the genus *Vanessa*, have their under surfaces of a dingy blackish-brown, with harsh transverse markings, their resting-places being the barks of trees.

Next, turning our attention to the moths, we find that the upper sides of the fore wings, with the thorax, and head, are the parts exposed to view in their sleeping hours, consequently these parts are very generally subdued in colour, forming, in many cases, strong contrasts to the brilliantly coloured hind wings; instances of this may be seen in the Death's-head and Eyed Hawk Moths. The singular resting position of the latter I have endeavoured to show in the accompanying cut (Fig. 3), drawn from life. Here the

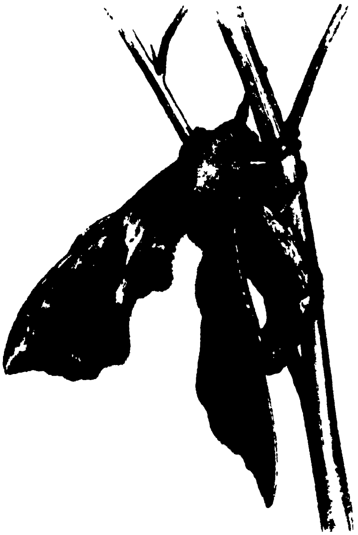


FIG. 3.—Eyed Hawk Moth at rest.

hind wings are seen to project a little beyond the fore wings on each side, in consequence of their being broader. The whole of the moth when seen in this position is coloured with various shades of brown, gray, and a brownish flesh colour, being wonderfully like a decayed leaf, and nothing like a moth at first sight. If we disturb this drowsy fellow, and can persuade him to spread his wings a little, we shall observe on the hind ones a large blue eye-like spot, inclosed with black, and surmounted by a beautiful carmine tint; this is shown in the figure at the head of this article. Many more interesting instances of Dame Nature's artful wiles for the concealment and safety of her innumerable children might be cited, such as caterpillars resembling twigs, not only in their colour and warty skins, but seeming to know what they are by their actions, or rather want of actions, in this case remaining, as they do, stiff and motionless for hours. One more example, however, must suffice for the present.

The chrysalis of the well-known and beautiful small Tortoiseshell Butterfly, when found on the nettle, or any other plant, is to the eye exactly like a small piece of pure gold, having the exact colour and glittering appearance of that metal; but marvellous to relate, if the chrysalis be found attached to an old wall, fence, or other lifeless object, we find no trace of the above-mentioned glitter, but a dark yellowish or reddish mottled gray, which varies according to the colour of the substance the insect is suspended to. Should this happen to be a tarred fence, the colour will be nearly black; this extraordinary fact seems to be unknown to entomologists, at least I judge so, by never having seen it alluded to in their works; it is nevertheless true, and I beg to call their attention to it. I have noticed this variation of colour in several other species to as great an extent, and those who take pleasure in the study of creeping things will do well to obtain a number of caterpillars of any one species of butterfly, give them plenty of fresh and proper food, and when they are about to spin remove them to boxes with their insides of different colours, some green, others brown, black or white. These boxes should have glass tops to admit light, as I fancy light has something to do with this phenomenon, which, however inexplicable as regards its cause, is perfectly intelligible in its effect, that of concealing each individual chrysalis as much as possible, and thus preserving it from harm. I may add, that the gilded individuals are always concealed by the leaves, under which they may be found suspended by searching at the proper time.

T. W. Wood.

HOW WE BEGAN SHELL-COLLECTING.

Conchology counts among its votaries people of every age, and rank, and station—artisans, professional men, successful merchants, kings, and princes. Christian VIII., King of Denmark, thought it an object worthy of his ambition to make the finest shell-cabinet in Europe; and that which he failed to accomplish has been again attempted by the young King of Portugal. At the present time the finest collection of shells ever made is the property of a private individual—Mr. Hugh Cuming—who lives almost within the shadow of the British Museum, and who has amassed in his cabinets the finest examples that could be procured of more than 12,000 kinds of shells—a number probably one-fourth greater than the series in the national collection.

Almost every conchologist with whom we are acquainted commenced shell-gathering at an early age, and we have no doubt their devotion to the pursuit was in a great measure due to this circumstance. The octogenarian, who still fishes with a silver net, was wont to explore the ponds and ditches in his school-boy days; and the great lady, who now commissions an agent to buy the "gloria-maris" or "cedo-nulli," at the price of a small estate, *was* the young girl who saved her pennies to buy less costly but not less valued treasures.

The earliest and pleasantest "half-holidays" of which we have any recollection, were devoted to long country rambles and searches for land and fresh-water snails. A visit to the seaside was rare then, before the railroad was made, and our part of the eastern coast was sandy and barren of life. But East Anglia is a country of ditches, and ditches, even more than rivers, are full of shells. We used to fish for them with a very simple and inexpensive kind of net: a shallow bag of green gauze, sewn to a ring of stout wire, about a foot across; the ends of the wire being bent at right angles, and sharpened with a file, were driven into the end of a long stick, furnished with a brass ferrule, not, however, so tightly as to prevent us from taking out the net when its work was done. The same net, whilst dry, served to sweep the herbage for beetles, or catch a butterfly in the air. For taking river-mussels, a longer stick and a stronger net, with the ring screwed to the handle, would have been necessary: but at that time we did not venture into deep water, and were content to overhaul the silt newly drawn from the river by dredgers employed to maintain the navigation. In these banks we found the swan-mussel and the painter's *Unio*, two sorts of *Paludina*, the pretty speckled *Neritina*, the river-limpet, and many other inhabitants of running streams. Similar opportunities occur near London, where hundreds of *Unios* and the *Cyclas rivicola*, etc., may be obtained in a short time with little trouble. When the bed of a mill-stream is laid dry, the young conchologist has a rare chance of getting into the mud and collecting shells; pigs also have a taste for river-mussels, and perhaps will anticipate his researches. It was in one of these mill-streams we were first delighted by finding the cases of the caddis-worm (*Phryganea*), made of shells, many of them still alive, and not much the worse for their durance. One of these grottoes is made of twenty-seven specimens of the compact little *Planorbis contortus* (each fastened by its upper surface) and one example of *P. marginatus* (Fig. 1). Some contained small bivalves (*cyclades*), and others afforded examples of a minute land-snail, *Vertigo palustris*, the first of the kind we had seen. Sir C. Lyell describes a fresh-water limestone in Auvergne, wholly made up—as he believes—of similar "indusia" of the case-worm, incrusted and cemented together with calcareous tufa.

Fig. 1.—Shell-grotto of Caddis-worm.

The neighbourhood of London is rich in land and fresh-water shells, especially the latter. The ponds at Highgate, the New River (at Hornsey and places more remote), the Lea River and marshes at Hackney, the Surrey Canal, running behind the Old Kent Road, are all rich in shells of *Unio*, *Anodon*, *Cyclas*, *Pisidium*, *Paludina*, *Neritina*, *Limnæa*, etc. The Paddington Canal, near Kensal Green, has of late afforded two species of *Cyclas* (Figs. 2 and 3) new to the British list,

Fig. 2.—Cyclas pallida. a, right valve; b, profile. Fig. 3.—Cyclas pisidioides. d, profile.
(From the Paddington Canal.)

and probably imported from abroad, like the mussel of the
morpha), which is also found there. But should the collector be very rapacious, and

Fig. 4.—Unio tumidus. u, umbo of right valve; f, foot; the arrows indicate the ... ratory ...

wish for more than he can himself carry, let him take a trip, by the lower road Deptford and Rotherhithe omnibus, to the

"Europa," near Church Street, Rotherhithe; or by rail from London Bridge to the Commercial Dock station, from either of which he can readily get to the Grand Surrey Docks. These timber-docks are literally *paved* with *Unio tumidus* (Fig. 4) and *pictorum*, *Anodon cygneus*, *Cyclas rivicola*, *Pisidium amnicum*, *Dreissena polymorpha*, *Paludina vivipara*, etc., all of the finest description and condition. To get at them, the best instrument is a sort of tin cullender (Fig. 5), about six inches across, furnished

FIG. 5.—Scoop for River-mussels.

with a hollow handle, which can be fitted tightly on the end of a stout walking-stick, when used. It will be desirable to choose good steady pieces of timber to fish from, and perhaps the water may be so deep as to require a jointed stick, or two sticks tied together. We visited these docks twenty years ago, with our friend Mr. Pickering, to whom we are indebted for all we have learned of shell-collecting in the realm of Cockayne, and we understand the locality as prolific as ever. Glass bottles or tin boxes are useful to bring home the smaller shells; tender species, like *Physa* and *Amphipeplea*, and minute things, like *Valvata spirorbis* and *Planorbis imbricatus*, require separate accommodation. The larger shells may be put in a canvas bag, which will allow the water to drain off; and it will be as well to clean them with a brush *before* boiling them. They should not be too much heated, or the shells will crack; and when the shell-fish has been removed, the valves should be closed and tied with tape or cotton until they are dry and stiff. If the interiors are delicately tinted with blue or salmon colour, the valves may be separated, or allowed to remain open.

The stations affected by fresh-water shells are very various, and the habits of closely-allied species differ considerably. The round fresh-water limpet (*Ancylus*) adheres to stones, in running water; the oblong limpet (*Velletia*) is found on stems of the water-flag and other aquatic plants, which should be pulled up and examined. *Cyclas rivicola* burrows in mud, whilst *Pisidium amnicum* climbs, with its long flexible foot, amongst the weeds. A hook on the end of a long stick may often stand in place of a net, for by drawing out the water-weeds, and shaking them over a clear spot, multitudes of shells may be obtained.

Mr. Pickering recommends the collector to search every nook, stream, ditch, and pond he comes to, as good shells are frequently met with in very unlikely-looking places; *Aplexa hypnorum* used to be found in a roadside rill—a mere gutter—beneath a hedge at Bermondsey; *Segmentina lineata* in puddles on the Hackney marshes, and in a pond by a public-house at Hoddesdon. The large pond-snail (*Limnæa stagnalis*) affects the most stagnant ditches; and we have found *Bithynia* and *Planorbis* at Romford, with their smaller whorls entirely destroyed by acid gases dissolved in the water. The beaks of the river-mussels are often corroded by the same agency. Such specimens are only kept in illustration of the influence of *unfavourable* circumstances; the best examples of each *species* are, of course, the finest and brightest that can be procured.

The best method of becoming familiar with the habits and economy of fresh-water shells, is to keep them alive in small glass jars, with some elegant water-plant, *Valisneria*, *Myriophyllum*, or *Hottonia*; the floating *Hydrocharis*, like a miniature water-lily; or the yellow *Villarsia*, which abounds in the Thames near Richmond. Shell-fish are more likely to thrive and multiply under separate treatment, than where many are crowded in a tank with fishes and other animals, although the only creature which perhaps actually eats the snails out of their shells is the larva of the dragon-fly.

Before quitting this subject we are tempted to refer more particularly to the fresh-water mussel, *Dreissena polymorpha* (Fig. 6), already mentioned as one of the

FIG. 6.—Dreissena polymorpha, showing foot, byssus, and respiratory siphons.

FIG. 7.—Three Dreissenas attached to Caspian cockle.

conspicuous shells of the London district. This bivalve resembles the salt-water mussel in form, and attaches itself in the same manner to stones, timber, and shells, by a *byssus* of strong threads (Fig. 6, *b*). It is a native of the Volga and other rivers of the Black Sea and Aralo-Caspian region; it occurs in myriads at Astrachan, and Captain Spratt has found it clustering upon the peculiar fresh-water cockles in the lakes of the steppe bordering the Danube (Fig. 7). It was unknown in England before the year 1824, when Mr. James de C. Sowerby presented specimens to the Linnæan Society, obtained from the Commercial Docks, where it was already abundant. and used by anglers for bait. It will survive a removal from the water for several weeks, and has been seen adhering to the logs of Baltic timber before they were unloaded from the ship.

In the older tertiary period there were other species of *Dreissena* inhabiting this country, whose shells are preserved in the fresh-water formations of the Isle of Wight. In middle-tertiary times the genus abounded in the Vienna "basin." But in the last, or pliocene period, it seems to have been reduced to a single species, inhabiting the rivers of the inland seas, from which it might never again have been diffused without the agency of man. In the last thirty years it has been naturalized in Holland and on the Rhine; and it is now found in almost every dock and canal in this country. Not less curious is the partiality of the *Dreissena* for darkness rather than light. In docks it thrives beneath the shadow of floating timber; and in canals abounds most beneath bridges. In 1853 Mr. Cunnington called our attention to its occurrence in the great iron water-pipes near the Paddington terminus, whose interior was half covered by the shells, fastened on by their *byssus*, and incrusted with a ferruginous deposit. In 1855, Mr. Gaskoin saw quantities of the *Dreissena* discharged from a water-plug in Cavendish Square; and in the following year Mr. Mylne (engineer to the New River Company) showed us specimens, in good condition, with zebra-like markings, obtained from a seven-inch water-pipe in Tottenham Court Road, at a distance of two miles from the nearest outlet. Mr. Bateman, the engineer of the Manchester water-works, has informed us that in 1851 that town was supplied with hard water from a shaft 300 feet deep, passing through drift-clay into the new red sandstone. The water was conveyed through an open channel, 200 yards long, to a reservoir, and both the channel and reservoir became completely lined with *Dreissena;* on every stone they clustered in myriads. And not only so, but they found their way into the water-pipes themselves, from those with a diameter of two feet, down to the five-inch pipes, even in the heart of Manchester; and they swarmed to such a degree that the pipes were often choked by them. More recently this source of water-supply was given up, and the town in now supplied with much softer water from a millstone grit district. Directly the change was made, the *Dreissena* ceased to multiply, and have now entirely disappeared; the soft water seems to have dissolved their very shells.

The environs of London are also good for land shells, especially the smaller kinds. The most minute of all, *Carychium minimum* (Fig. 8), occurs in the woods, as at Hampstead, and *Acicula fusca* and *Achatina acicula*, at the roots of grass on canal banks; they may be obtained by shaking the moss and roots over a sheet of paper. *Clausilia*

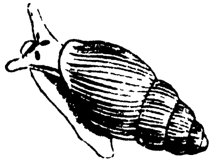


Fig. 8—Carychium minimum, highly magnified.

Fig. 9.—Cyclostoma elegans.

bipicata is found at the roots of willows by the Thames; and the rare *Clausilia rolphii* is still to be procured in its original habitat, Charlton Wood, between the church and the lower road. The operculated *Cyclostoma* (Fig. 9) is also found at Charlton, but more abundantly on chalk banks near Gravesend. Many of these small shells, which live in dark and shady places, under bark, and in the ground (or even in houses, like *Helicella cellaria*), feed on decaying vegetable and animal substances; and, since their sense of smell is very acute, the best trap for them is an old board, rubbed over with a piece of meat, and placed on the ground, beneath the ivy and dog's-mercury, or other plants in the woods, or in the thickets on a hillside. The same kind of trap, an old board, baited with dead worms, will often show the existence, in London gardens, of that curious slug, the *Testacella*, which lives in the ground, feeding upon earth-worms, and wearing its shell externally, like a small buckler, to defend its rear. It is sufficiently conspicuous by its bright yellow colour, and gardeners often meet with it when removing plants in autumn. It is a native of the south of Europe, Madeira, and the Azores, and has only been naturalized in England of late years. A larger species, *Testacella maugei*, pink beneath and blackish above, has long been found in Mr. Miller's nursery at Clifton, and more recently (by Mr. William Cunnington) in fields near Devizes (Fig. 10).

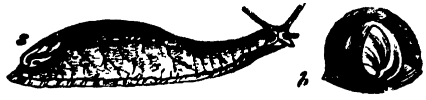


Fig 10.—Testacella haliotidea. *s*, shell; *b*, end view of a specimen which has been disturbed from its winter sleep, showing the mantle partly expanded round the shell (both figures reversed).

It is a constant complaint with new colecltors, that they can find nothing but *dead* shells, bleached by exposure to the weather. This is because they search in fine summer weather, when most of the snails have hid themselves, and become dormant for a time. A shower, after long drought, brings out the snails in multitudes, as if they had fallen from the sky. At such times we have taken *Helix carthusiana* (at Sandwich), and some small Vertigos, by sweeping herbage and grass with a *white* gauze insect-net. The great Roman snail (*Helix pomatia*), found at Boxhill in Surrey, Charing in Kent, Ware in Hertfordshire, and many other places on the chalk downs and Cotteswolde hills, buries itself in the ground during the hottest part of summer; but in a moist spring or autumn morning, hundreds may be found walking about, "with steps most majestic,' in the dewy grass. Autumn is the best time to collect, or open weather in winter, because then the snails of the previous year have attained their full growth. Those which have seen many winters are weathered, and more or less bleached.

The conchologist, whose gatherings are restricted to the produce of a single district, however rich it may be, will find that when he has exhausted all the localities within reach, his collection is still deficient in examples of many of the British species.

Bulimus Lackhamensis is only met with in beech woods on the chalk, as at Bury St. Edmund's, and the Roundway Hill, Devizes, or on the Cotteswolde at Birdlip. *Helix lamellata* is found at Scarborough and at Cork; *Helix pisana*, at Tenby, and at St. Austell; and so on with many others. But if the collector has been successful in finding a few of the rarer or more local species in tolerable abundance, and if he will be at the trouble to procure good and perfect specimens, and prepare them neatly, he may soon establish a correspondence and system of exchange with collectors in other parts of England; if he has anything good to offer, there will be no difficulty in meeting with others similarly circumstanced, or he may learn something of them through the pages of Mr. Newman's popular magazine, the "Zoologist," and, possibly, amongst the subscribers to RECREATIVE SCIENCE.

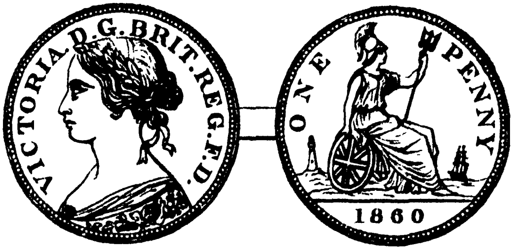
We have already mentioned most of the London shells which are good for exchange, and recommended the collector to clean *before* killing them, not to overheat the shells, and only to keep good specimens. It is scarcely necessary to prescribe *implements* for this work; little more is required than a tooth-brush or two, of different degrees of hardness; a few needles, of various sizes, fixed in short, light handles, made of paint-brush sticks cut in halves (handles like those of crotchet needles are too heavy), and some of these needles may be softened in the flame and bent into any curve required. Another necessary article will be a pair of steel forceps, with *curved* points, such as can be procured at Baker's in Holborn, or (at a higher price) of any instrument-maker. There are some slender, spiral shells, like *Clausilia* and *Azeca*, whose colour and translucency are much improved by the extraction of the animal; but when suddenly immersed in hot water they retract beyond the reach of any needle. If the shells are to be cemented on tablets, the animal may b got out through a hole made in the *back* of the shell; but this is not satisfactory, and it is better to drown the animals in tepid water, and when they have become too dropsical to retract, there will be a better chance of extracting them. A few should be tried at a time, and placed in cold water after being boiled.

Land and fresh-water shells being mostly very light and fragile, are often arranged on cards, placed in card trays; the localities and dates are written under the specimens, and the names on the front edge, which is turned up. The river-mussels may be kept loose in the trays, or laid on cotton-wool. The best cement is "Ackermann's" (126, Strand); or, if gum-arabic is used, it should be mixed with a little glycerine, to give it tenacity; some use gum-tragacanth, which is more like paste. About 1837, a young medical student of our acquaintance, Mr. Daniel Cooper, published a little collection of British land and fresh-water shells. It was in the form of a thick octavo volume, and, when opened, disclosed a set of little shelves, capable of being drawn out, on which were fastened examples of all the species he could procure, with blanks for a few rarities not easily obtained. Another collector, to economize space, keeps his card of shells in drawers, fitted with wooden racks, as slides for the microscope are kept; the specimens are less secure in this vertical position, and cannot be seen until taken out.

The book we had for learning the names and history of these shells was Dr. Turton's "Manual" (12mo, 1831), an elegant little work, with coloured figures of all the species. A larger edition has since been published, with excellent figures, from his own cabinet, by Mr. J. de C. Sowerby. The best book for these and marine shells is the "British Mollusca," by Messrs. Forbes and Hanley; or, Mr. G. B. Sowerby's "Illustrated Index," with coloured figures of all the species.

S. P. WOODWARD.

British Museum.



New Bronze Penny.

THE OLD COPPER AND THE NEW BRONZE COINAGE.

To a highly civilized and commercial people there are few subjects of more general interest than those of money and money-making. The value and importance of money come to be understood at a very early period in the lifetime of us all, and too often, alas, the desire for accumulating it pursues us to the very close of existence. It is not, however, with the question of money in its moral aspect that it is now proposed to deal, but in a literal and manufacturing sense. It is known that the Government have determined to remodel the inferior coinage of Great Britain, and to substitute for the heterogeneous mass of copper coins, which under the name of pence, halfpence, and farthings, are now circulated among her Majesty's lieges, an entirely novel coinage of bronze. Judging by the mutilated, worn, and sadly deteriorated condition of the doomed money, it must be allowed that the reformation does not come one hour too soon. It is intended to furnish the readers of RECREATIVE SCIENCE with some particulars in relation to the forthcoming coinage, and, perhaps, hereafter to enter more fully into the art of money-making generally. As a preliminary step to the complete elucidation of the subject chosen for the present paper, it may not be deemed improper to supply some statistical information in reference to the coinage which will shortly be committed to the furnace.

Setting aside the numerous counterfeit and foreign coins which have crept into circulation in the British Isles, and which add materially to the annoyance of the public, there are no less than four varieties of legitimate copper pieces, of the denominations named above, current among us. These have been introduced at different times, and are of different weights and sizes. The oldest are those which were struck by contract in 1797, and they are the largest and heaviest variety. They have been popularly named the "cart-wheel" coinage, from their great diameter and the fact that the pence have a broad band, or protecting edge, round them. These were originally intended to serve as representatives of weight as well as value, and thus to become a check upon dishonest shopkeepers. The pence, accordingly, weighed precisely one ounce each, the halfpence half an ounce, and the farthings a quarter of an ounce, avoirdupois. If a purchaser wished, therefore, to assure himself that he was not being defrauded, he had only to check the seller by placing his money in the scale instead of the seller's weights. Of course, there were sixteen pence, thirty-two halfpence, and sixty-four farthings to the pound in the cart-wheel coinage. In 1799, these proportions were, however, abandoned, and another issue of copper coins, also from the presses of contractors—Messrs. Boulton and Watt, of Soho—was made. The pound weight, in this instance, was coined into eighteen pence, thirty-six halfpence, and seventy-two farthings, the reduction in size being made because the market price of copper was found to increase, and the heavy coins found their way into the furnace of the manufacturer. In 1805 a still further diminution of size and weight was instituted, and the pound of copper was converted into twenty-four pence, forty-eight halfpence, and ninety-six farthings. This particular issue, however, was intended only for circulation in England and Scotland, a distinctive division of the pound being made for Ireland. This latter consisted of twenty-six, fifty-two, and one hundred and four, respectively, for the three denominations. It is many years, however, since justice was done to our Irish fellow-subjects in this respect, and from the year 1823 to the present time, the one pound of copper has been coined into twenty-four, forty-eight, and ninety-six pence, halfpence, and farthings.

After the establishment of the Royal Mint on Tower Hill, in 1810, almost the whole of the coinages of copper were executed without the aid of contractors. The superior mechanical appliances then introduced enabled successive Governments to keep pace with the ever increasing demands for coin of the realm, and it is only now that those appliances are found inadequate to stem the pressure exerted upon the Mint.

Without going more minutely into the annals of the metallic currency, or showing the gradually growing necessity for adding to the quantity of "hard cash" in circulation which the last half century exhibits, it will be well to give the actual number of pieces of copper money now presumed to be in existence in Great Britain and her dependencies. Allowing, then, .. considerable margin for losses and disappearance of coins in all other ways, there is no doubt that the copper coinage, of the varying sizes and weights mentioned, comes very nearly to the totals given in the annexed table, viz. :—

			£		Tons.
Twopenny pieces....	722,200	=	6,000	=	27
Penny ,, ...	114,690,984	=	477,800	=	2133
Halfpenny ,, ...	262,554,497	=	546,900	=	2141
Farthing ,, ...	99,956,004	=	104,100	=	164
Half-farthing ,, ...	16,438,176	=	68,000	=	306
	494,361,861		1,203,300		5371

Or very nearly five hundred millions of pieces of all denominations.

In reference to this statement, it may be mentioned that the twopenny pieces, which were all struck towards the close of the last century, and which weighed two ounces each, are supposed to exist in collections and hoardings; as they are seldom visible, whilst the half-farthings, designed by Sir Robert Peel for home use, and issued principally in 1842, repudiated by an "enlightened British public," have found a local habitation in Ceylon.

It will be seen, at a glance, that the supercession of the copper coinage is not a trifling task. It is proposed to effect the operation as speedily as possible, and when the maximum number of pieces of money, whether of gold, silver, copper, or bronze, that the presses of the Mint are capable of stamping per day, does not exceed 200,000, it will "require no spirit from the grave" to tell us that contractors' presses will have to be enlisted, and those to a considerable extent. The products of sixty-three years' minting have to be superseded in, say one year, or thereabouts.

So much for the old coinage of copper; and now for the new one of bronze. From the latest information given on this part of our subject, by Mr. Gladstone, it appears that the artist, Mr. Leonard C. Wyon, has been busily engaged for months past in preparing the dies for it, and that in a few more months a considerable portion of the newly-minted coins will be in the hands and pockets of the people. Above we have given *fac-similes* of the designs for the bronze penny, and, of course, those for the halfpence and farthings will be the same on a smaller scale. A very considerable reduction of weight, as compared with that of any of the specimens previously referred to, will be found to distinguish the whole of the forthcoming pieces of money. The one pound weight of bronze will be coined into forty pence, eighty halfpence, and one hundred and sixty farthings, so that the proportions are pretty nearly one-half less than those with which the public have been previously familiar. The diameter of the penny will be 1·200 inches, that of the halfpenny 1·000 inch, and that of the farthing ·800 inch. The metal to be used is identical with that employed in the most recent French bronze coinage, and which has worn so well. It consists of pure copper ninety-five parts, tin four parts, and zinc one part. The bronze coinage, soon to be forthcoming, will possess, therefore, the advantages of being less burdensome in the pocket, of having a golden hue, being free from the unpleasant odour of copper, more durable, and more handsome than the expiring varieties of copper coin.

However some may be disposed to imagine that the emblem of Britannia seated on her lone rock, by the "sea-beat shore," ought to have been dispensed with, as having done duty there long enough, all will be glad that the current value of the pieces will be stamped plainly upon them, and that they will insure uniformity and simplicity, where all before has been irregular and perplexing.

J. N

Royal Mint.

THE COLLODIO-ALBUMEN PROCESS OF PHOTOGRAPHY.

For those who wish to practise landscape photography, or to take photographs of any

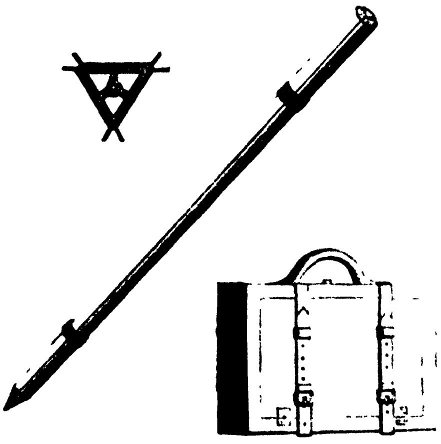


Fig. 1.—Kinnear's Camera, and Stand.

objects at a distance from the operating room, what is termed a "*dry process*" is indispensable. Great ingenuity has been brought to bear in the invention of photographic tents, portable operating-rooms, dark boxes, vans, and even photographic cabs and wheel-barrows; these have for their object to render the collodion process, in its simplicity, capable of being used in the field, and certainly the idea of pitching one's tent in a shady nook near a stream, in the midst of beautiful scenery, taking negatives, and knowing that they are good before one leaves the spot, is rather captivating; but, unfortunately, there is much to dispel the illusion. The great weight and bulk of the tent and bath, bottles and chemicals, plate-box and plates, besides the camera and stand, and the host of difficulties and annoyances which are inseparable from tent life, are such that few amateurs care to go out with a tent a second time. With a "dry process," a person may go from home for several weeks with no other photographic encumbrance but his portable camera and stand (Fig. 1), and a parcel of sensitive plates, take the views he wishes, and return home to develop them at his leisure. It is sometimes stated that a "dry process" can never produce pictures equal to a "wet one;" that the negatives are hard, and wanting in atmospheric effect. In answer to this, a prize medal was recently offered by the Photographic Society of Scotland for the best landscape by any process, open to all the world; the medal was awarded to a landscape taken by the collodio-albumen process, which is the one now to be described.

Many processes have been invented for the preparation of sensitive dry plates, and every month sees the publication of one or two new ones; but none of them appear to equal this in the certainty and the beauty of the negatives. The apparatus required, in addition to that for the wet collodion process, are—

A glass bath and dipper for aceto-nitrate solution.

A levelling stand (Fig. 2).

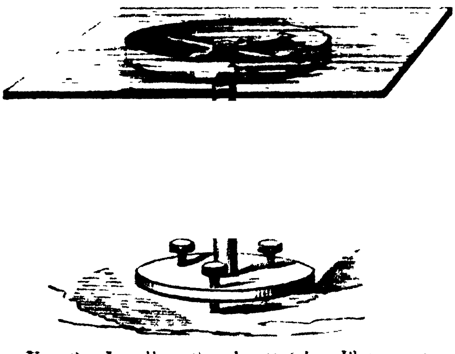


Fig. 2.—Levelling Stand with Glass Plate on it.

Two four-ounce beaker glasses and small funnel (Fig. 3).

The chemicals required are—

Solution of aceto-nitrate of silver to fill bath.

Prepared album[e]n.

Prepared collodion for "dry process."

Pyrogallic developing solution.

Silver developing solution.

Fixing solution.

As stated in the former paper, the best plan for an amateur, who has not much time at his command, is to get most of his solutions as nearly ready for use as possible, and to procure them from a person who *understands* the process, and therefore knows exactly what is requisite. The formulæ are, however, here given for the solutions, for those who prefer to prepare their own:—

Prepared Albumen.

White of egg	1 oz.
Water	¼ oz.
Liquor ammoniæ	10 minims.
Iodide of potassium	5 grains.
Bromide of potassium	1 grain.
Tincture of iodine	1 minim.

Beat up well together; allow to stand and filter. It will keep good many months.

Aceto-nitrate Bath Solution.

Distilled water	1 oz.
Nitrate of silver	40 grains.
Glacial acetic acid	25 minims.

Pyrogallic Developing Solution.

Water	1 oz.
Pyrogallic acid	2 grains.
Citric acid	½ grain.

Filter.

Silver Developing Solution.

Water	5 oz.
Nitrate of silver	10 grains.

Filter.

Fixing Solution.

Water	10 oz.
Hyposulphite of soda	5 oz.

Pour collodion on the plate, and immerse it in the nitrate of silver bath, as in the ordinary collodion process; when it is ready, remove it to a dish of water, agitate it a little, and then take out the plate, and wash it *well* under a gentle stream of water; allow it to drain for half a minute, and then pour on some of the prepared albumen, let it flow over, and drain off at one corner; repeat this four times, and each time pour off at a different corner, taking care to avoid bubbles and dust. A good plan to adopt is to have two thin beaker glasses of the same size, and a small funnel fitting into one of them (Fig. 3, A), plugged with a bit of fine

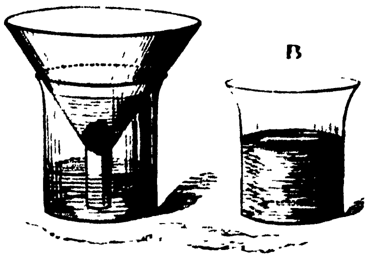


Fig. 3.—Beaker Glasses for Albumen.

sponge; pour the albumen from the plate into this funnel, the sponge will filter all bubbles, etc., and leave it clear; when all the albumen has been used out of B, change the funnel to B and pour from A; the albumen may thus be used three or four times over. When the albumen has well drained from the plate, dry it at a fire or stove, the prepared side towards the fire; when cool, store away in plate-box.

In this state the plate is not sensitive to light, and will keep good a very long time; it is consequently advisable, when all the apparatus and materials are in order, to prepare several dozens of plates for future use: from fifteen to twenty plates may be prepared in an hour, by arranging the different operations so as to lose no time between each in waiting. The preparation of the plates should be conducted in the dark room, until the albumen has been poured on, when they may be exposed without injury to daylight.

To render the plates sensitive, immerse for about half a minute in the aceto-nitrate bath, then place in a dish of water, and afterwards wash *very well* under a stream of water, and rear up to dry; when quite dry, put them in the dark frames and plate-box; or, in case of travelling, the plates may be packed together, a sheet of clean writing-paper between each, and well wrapped up in several folds of paper; packed in this way they will keep good three or four weeks, even in very hot weather.

The exposure required varies according to the view to be taken, the amount of light, focus of lens, etc. For a picture of a well-lighted landscape, Rosse's orthographic lens with medium stop being used, about five minutes are sufficient; some views would require even two or three times as much, but a trial or two will give more information than as many volumes written on the subject.

Development of the Image.—Remove the plate from the dark frame, and pour water so as to wet all the surface; then place it face upwards on the levelling stand, and pour on from the developing cup some of the pyrogallic solution; pour this off and on once or twice, and then allow it to remain for a few minutes; then pour it off, and mix with it three or four drops of the silver developing solution, and pour it on and off again several times: the image will now appear, and keep gaining intensity until finished. Should the development be very slow, a little more of the silver solution should be added; but as little silver should be used as possible, as it is apt to decompose the pyrogallic solution, and turn it black, when it must be thrown away, and the plate washed before fresh solution is used.

As in the collodion process, an under-developed negative has the lights and shades in *too great contrast*, one over-exposed has *too little*; much may be done in the development to remedy this. Pyrogallic acid *develops the image*, nitrate of silver *intensifies it*. To fix the image, place the plate in a dish containing the hypo-solution; when the blue film has disappeared, wash well with water and rear up to dry, and afterwards varnish with the French varnish.

The above process is much longer in description than in practice; it requires care and patience, but with these and the use of suitable chemicals, success is certain; and when one considers how valuable is a good negative, on account of its power to produce an unlimited number of prints, superior to any drawings in beauty and accuracy, the time taken in its production is marvellously short. JOSEPH SIDEBOTHAM.

Manchester.

THE THERMOMETER AND TEMPERATURE.

THE thermometer is an instrument which shows us the variations of temperature. From it we are made aware of the fact, that bodies expand or increase their bulk on being heated, and contract or become smaller on being cooled. Each body is acted upon in a different degree; the expansion being small in solid bodies, greater in liquids, and considerable in aeriform fluids.

There is some degree of uncertainty regarding the invention of the thermometer, which took place at the beginning of the 17th century, being attributed to Dr. Drebbel, of Alkmaer, according to some, and to Professor Santonio, of Padua, according to others. The first instrument was imperfect, being acted upon by atmospheric pressure. However improvements have gradually been made from time to time by Boyle, Newton, Amontons, Reaumur, Fahrenheit, De Lisle, Celsius, Sixe, Breguet, Rutherford, Phillips, Negretti and Zambra, and others, until the instrument has become a very perfect one; Amontons substituting spirits, Fahrenheit mercury, and Breguet taking advantage of the unequal expansion of different metals.

Until the invention of self-registering thermometers, the temperature could only be ascertained at the moment of observation. Now the case is very different, we have various contrivances by which the greatest heat and cold may be marked, so that the actual range of temperature can be accurately recorded.

The thermometer in its present perfect state is a very small tube, terminating in a bulb or reservoir, and filled either with alcohol or mercury. It is essential that the spirit shall be free from atmospheric air; and to accomplish this it is boiled in the thermometer until the air becomes expelled, and then the tube is hermetically sealed. It is fortunate that two fixed points can be found by which the instrument-makers may construct thermometers alike. Under the same atmospheric pressure all instruments, when plunged in pounded ice or melting snow, will indicate the same point, viz., + 32° F., or when exposed to the vapour of boiling water, another fixed point, viz., + 212° F. Of course if the workshops be not situated at the *sea level*, an allowance must be made for the difference of pressure; it is also essential to make a further allowance for the height of the barometer at the time of constructing the thermometer. The bore of the tube should be even, the zero points accurately determined, and the graduations performed with exactitude. In ordinary thermometers these several conditions are not properly fulfilled; therefore, unless instruments are purchased from a well-known optician, and at a more than ordinary price, the observer must be content to possess an instrument which will only approximate to the truth, for it is not unusual to see two ordinary thermometers showing a temperature of say from 2° to 6° or 8° difference. Assuming that the instruments used are correct, the observer will require:—

1. A maximum thermometer for determining the greatest heat of the air.

2. A minimum thermometer for determining the greatest cold of the air.

3. A maximum thermometer for solar radiation.

4. A minimum thermometer for terrestrial radiation.

5. A dry and wet bulb thermometer for hygrometrical purposes.

6. A maximum wet bulb thermometer for determining the maximum temperature of evaporation.

7. A minimum wet bulb thermometer for determining the minimum temperature of evaporation.

With the exception of Nos. 3 and 4, which require placing on the grass, these instruments should be placed on a proper stand, with their bulbs four feet from the ground. (See Figs. 10 and 11.)

The Council of the British Meteorological Society have adopted the thermometers of Messrs. Negretti and Zambra, of Hatton Garden, a firm who have paid especial attention to meteorological instruments, and who have invented several valuable improvements in thermometers, to be hereafter enumerated.

Of the maximum thermometer, there are two constructions now adopted, viz., *Rutherford's*, which till lately was in general use: it has a steel index introduced into the tube, above the mercury, which is pushed forward by the expansion of the mercurial column, being *left* at the point of maximum heat. Owing, however, to the tendency of the steel index to become fixed in the tube, either by plunging into the mercury, or, by its oxidation, allowing the mercury to pass it, this instrument is liable to frequent derangement. The other construction, known as Negretti and Zambra's *Patent Maximum Thermometer*, is an instrument which, except by actual breakage, is not liable to get out of working order. This thermometer (Figs. 1 and 9), whilst the tube is straight, has a

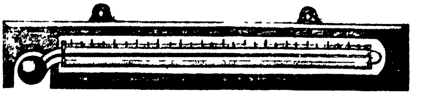


FIG. 1.—Negretti and Zambra's Patent Maximum Thermometer.

small piece of glass passed into it which nearly fills the bore; this glass is pushed down to near the bulb of the thermometer and the tube bent at this part, as shown at A, Fig. 6. On the temperature rising, the mercury is forced past the obstruction, yet on a decrease of heat it cannot repass, the contraction taking place below the bend. The end of the mercurial column is thus the point of maximum heat. In practice the instrument is hung horizontally; and after a reading has been made, it is reset by raising the end furthest from the bulb, and giving a gentle rap or shake.

A third form of a self-registering maximum thermometer, invented by Professor Phillips, is better in its action than Rutherford's. In it the mercurial column is separated by the introduction of a small portion of air: on rising, the whole column is pushed forwards, but on falling again that portion above the air is left in the tube. When in perfect working order, it is a very nice instrument, but unfortunately it is liable to become deranged.

Thermometers for showing the greatest degree of cold are (with the exception of the recent invention of Messrs. Negretti and Zambra) filled with alcohol, having a glass index floating in the liquid; as the temperature cools the index is carried down with the fluid, but on a change taking place the alcohol alone ascends, leaving the index to mark the point of minimum cold; having read off, the instrument (and it must be borne in mind that it is the top of the pin that is to be read) is reset by simply raising the bulb until the index glides to the end of the spirit furthest from the bulb. There is an objection to alcohol, as the expansion is not equal with equal increments of heat. The expansion of mercury being more even than that of any other fluid which can be made applicable for thermometers, meteorologists have

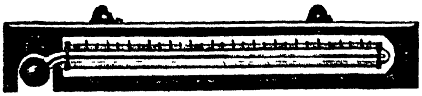


FIG. 2.—Negretti and Zambra's Patent Minimum

long been anxious for a mercurial minimum thermometer, and this has now been constructed by Messrs. Negretti and Zambra. The instrument is placed vertically, and has a needle with an abrupt point resting on the mercurial column. As the mercury in the cylinder contracts from the effect of cold, that in the tube descends, and the index by its own gravity follows it; on the contrary, as the mercury expands and rises in the tube, it passes the index on one side, and in rising exerts a lateral pressure on the needle, and jams it to one side of the tube, where it remains firmly fixed, leaving the upper point of the needle indicating the minimum temperature. In this thermometer the reading is always from the upper point of the needle, and not from the mercury itself. To extricate the needle from the mercury a magnet is used, when, if only embedded a few degrees, it can be withdrawn without altering the position of the instrument. Should the magnet, however, not be sufficient, the thermometer is then turned on its support from the upright position, slightly elevating the bulb (Fig. 4). The mercury and index will then flow into the small reservoir. If the index does not leave the tube with the mercury, assist it with the magnet. Whilst holding the index with the magnet in the reservoir, again bring the thermometer to the upright position, when the mercury will immediately fall back into the tube,

FIG. 3.

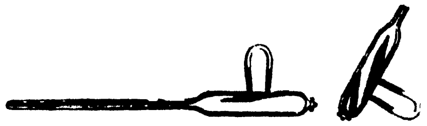


FIG. 5. FIG. 4.

Mercurial Minimum Thermometer.

leaving the index attached to the magnet (Fig. 5), with which it is to be guided down to the mercury ready for another observation. The magnet must not be withdrawn until the index touches the mercury, for if released too soon it might plunge too deeply, and give a false indication. The instrument is free from air, and therefore an improvement on the Rutherford construction.

The "solar radiation thermometer" (Fig. 6) and the "terrestrial radiation thermo-

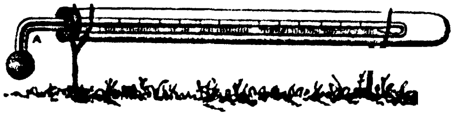


FIG. 6.—Solar Radiation Thermometer.

meter" (Fig. 7) are made entirely of glass, having a piece of enamel at the back; in order that they may be more easily read off,

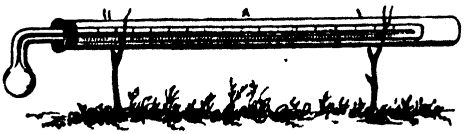


FIG. 7.—Terrestrial Radiation Thermometer.

they are both suspended on forks of wood amongst short grass. Self-registering alcohol thermometers should have their bulbs slightly depressed, in order that the indices shall be assisted by gravitation.

Recently another instrument has been invented by the same eminent firm, and called the "Vacuum Solar Radiation Thermometer" (Fig. 8), a blackened bulb maximum thermometer, being inclosed in a glass

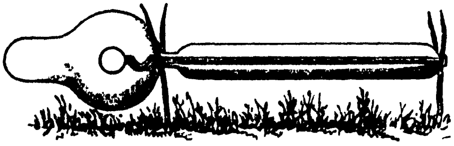


Fig. 8.—Vacuum Solar Radiation Thermometer.

tube and globe, from which the air is exhausted. The instrument works well, and therefore we have now a solar radiation thermometer, the readings of which are comparable with each other.

Dry and wet bulb thermometers (or the the psychrometer, Fig. 9) consist of two thermometers as nearly identical as possible, the bulb of one being covered with thin muslin, round the neck of which is twisted a conducting thread of lamp-wick or darning-cotton, passing into a small vessel of water, which is placed as far as possible away from the one with a dry bulb; indeed, it is safe to have a card or thin piece of metal between the bulbs of the two thermometers, for fear of the dry bulb reading a little too low, from the influence of the water. The maximum and the minimum wet bulb is simply adopting self-registering thermometers, the latter instrument, owing to the difference of the readings at night being small, may be dispensed with; but the maximum wet bulb is a valuable addition to meteorological instruments, because usually the greatest differences between the dry and wet bulb occur at the points of maximum heat, and without it these results would be lost. It is absolutely requisite that every observer's thermometers shall be placed under similar circumstances.

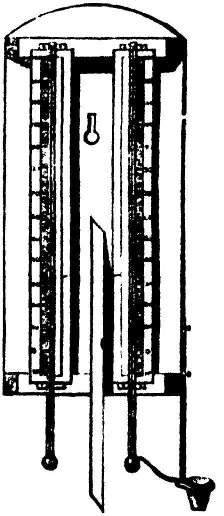


Fig. 9.—The Psychrometer.

There are two forms of thermometer stands, the one constructed by Mr. Glaisher, and known as "Glaisher's Thermometer Stand" (Fig. 10), and the other invented by the late Mr. Henry Lawson, and called "Lawson's Meteorological Thermometer Stand" (Figs. 11 and 12). There is one advantage in the latter over that of Mr.

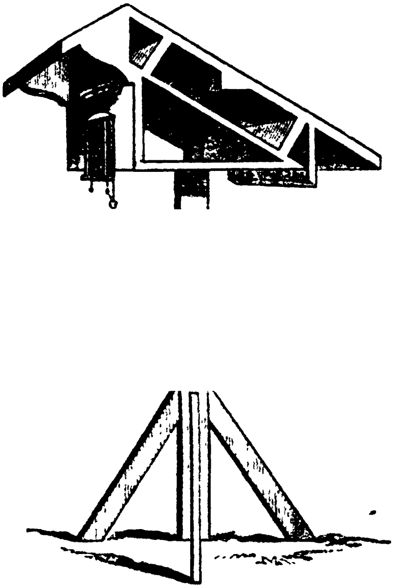


Fig. 10.—Glaisher's Thermometer Stand.

Glaisher's, its north side always facing the north, whilst the instruments on the south face will have the meridian sun; whereas Glaisher's stand requires moving from time to time. Without the use of a stand, records cannot be comparable with each other. In ordinary use thermometers are hung facing the north, south, north-east, north-west, etc.; some two, three, five, ten, or twenty feet above the ground; some embowered, others sheltered by high walls; some touching a wall, others distant from it; some in situations cool as a cellar, and others exposed to the sun's rays at a certain hour or hours of the day. It is obvious that records made in

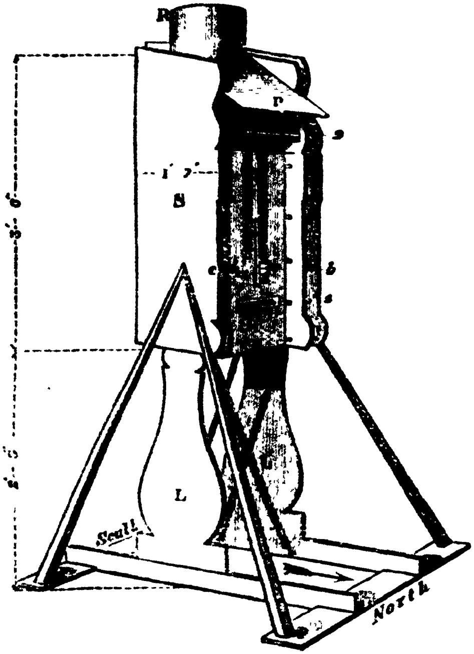


FIG. 11.—Lawson's Thermometer Stand.

such situations, under such circumstances, simply give us erroneous statements, and as a thermometer stand is not costly, every observer should possess one.

The following is a description of Mr. Lawson's stand:—Fig. 11 is a frame, which has been found to answer the intended purpose well. It is composed of *white deal* boards, and can be formed or constructed by any carpenter. It consists of an oblong trunk, T, twelve inches by eight inches, outside measure; to the opposite sides of which trunk are nailed boards, *b b*, at the distance of three-quarters of an inch, and projecting about six inches from the trunk towards the north. Outside of these are nailed other thin boards *c c*, full half an inch distant, and projecting about four inches beyond the last-mentioned boards, also towards the north. These sides (or shades) being multiple, prevent the sun from heating the interior of the stand where the thermometers are placed. The top, or pent-board, P, is made double, and the boards are placed fully three-quarters of an inch distant from each other, and come so forward as to overhang, by a full inch the night index thermometer, placed immediately beneath, for the purpose of preventing rain or dew from falling perpendicularly upon the bulb of the thermometer. The legs L L, of the stand are merely the continuation of the sides of the trunk. The board or feet, F F, are loaded or fixed to the ground to sustain the force of the wind. The interior, T, is blackened to prevent strong reflections of light.

Fig. 12 is a ground-plan, a bird's-eye view of

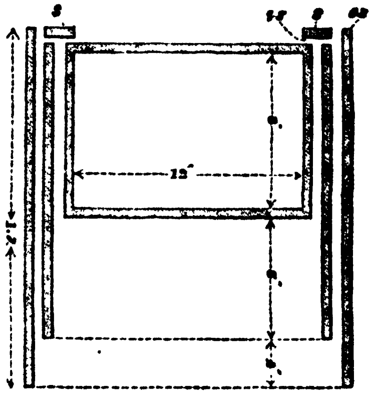


FIG. 12.

the machine. The sides (and wood-work generally) are of three-quarter-inch white deal The distance or space between the sides of th trunk, T (Fig. 11), and the board, or inner side, *i s* (Fig. 12), is three-quarters of an inch; and the distance from that board to the outer side, *o s* (Fig. 12), is full half an inch. The narrow boards, *s s* (Fig. 12), are to be nailed, with studs intervening, to the middle board or side, *i s;* and are for the purpose of preventing the sun from shining between the trunk and the sides, *o s* and *i s*, when near the meridian. The sides are fixed, one upon the other, at the required distance (viz., three-quarters of an inch, and half an inch), by numerous wooden studs, shown in Fig. 1, about three-quarters of an inch diameter; and the nails or screws passed through the sides and studs, fixing the whole firmly together. The whole is to be painted white, except the face of the trunk, T, which may be black, to prevent strong reflections of light.

E. J. Lowe.

Highfield House Observatory.

(*To be continued.*)

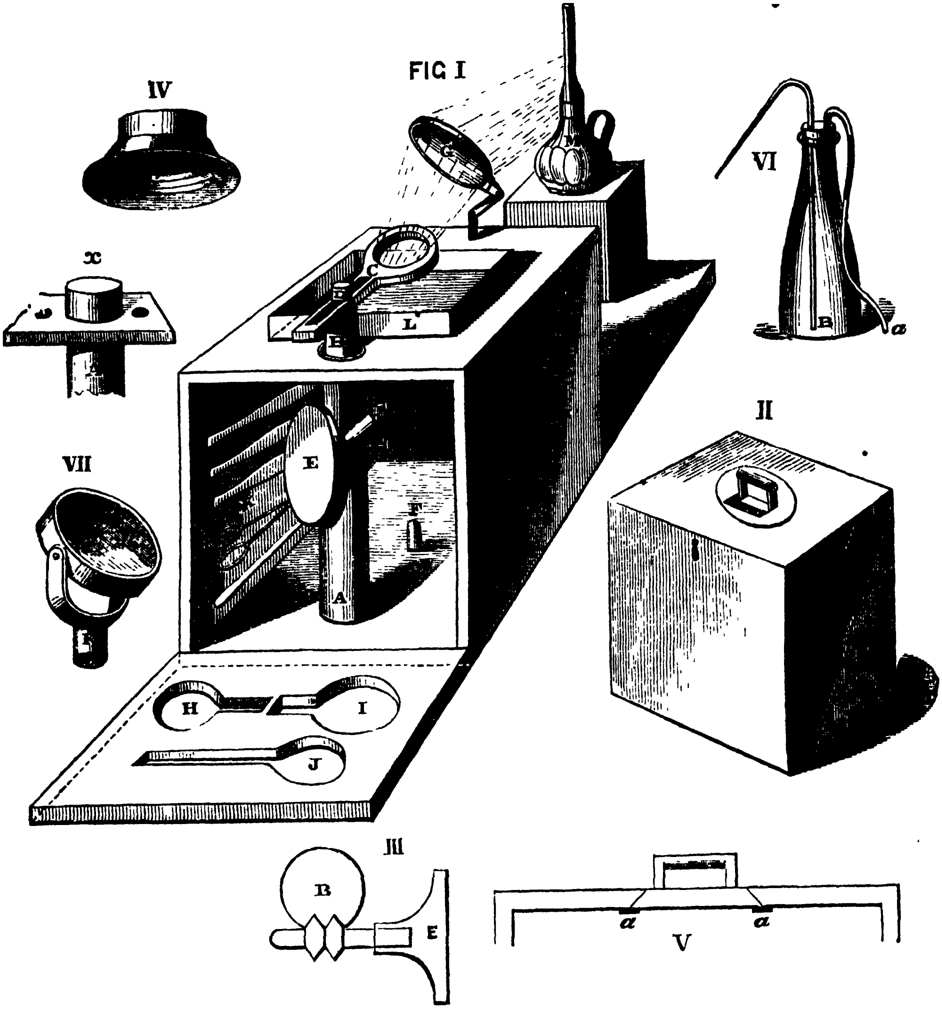
CONSTRUCTION AND USES OF A DISSECTING MICROSCOPE.

In years gone by, I had but a very faint glimmering of the path to be trodden, and the best means of attaining that knowledge which I was thirsting after as a microscopist. Since then a light has dawned upon me, which has led me to look rather to my own labour than to a reliance upon the labours of others, convinced that while I might purchase objects, I could not purchase knowledge. Thenceforth I determined to earn my wisdom by perseverance and individual research. The labours of Swammerdam, Leeuwenhoek, Lyonnet, and Strauss Durkheim, which, in the early days of microscopic science, had effected so much with such imperfect instruments, gave me reason to hope that I, too, might do what they had done, with the better means at my command; but I found my task a hard one, my case apparently hopeless, inasmuch as my brazen cylops, with its bright magnifying power, was powerless to reveal to my eyes what they had seen; in short, it was incapable of penetrating the secrets which lie hidden in the structures submitted to its scrutiny. In my ignorance I understood not the organization of cells and tissues, nor that great law of Nature which teaches us that the higher in the scale of life the more need for elaborately-prepared food, transformed from the rude elements, the mineral and organic combined, first by plants, to form materials fitted for the support of animal life. With such my microscope was a parallel, and hence my inability to see what others had seen. Perhaps you have found it the same, and have risen from your labours dissatisfied, feeling that you had wasted your money and time with little hope even of future profit, wondering the while how others had succeeded in seeing those beauties, whose descriptions had enchanted you, and made you impatient to see the like. Such have been my feelings, and sympathizing with the young microscopist in his difficulties, I have taken upon me the pleasing task of pioneer, with the hope that I may assist him in unravelling the tangled skein which now perplexes him. To effect this, I must introduce to your notice the Dissecting Microscope, which shall play the part of a jackall in providing food for your brazen lion, and yield you, its owner, a rich banquet of delight and profit, if you will patiently follow my directions, and enter upon the path that I shall strive to trace out for you. There are but few difficulties to be encountered, and these of little note. A few failures must not daunt your enthusiasm, but with *Excelsior* for your motto, you must be ever looking forward to the pleasure that will surely flow from an intimate acquaintance with the minute works of the great Master Builder.

The construction of the Dissecting Microscope, unlike the compound achromatic, is simple, and easily made by any one of ordinary mechanical ability, at the cost of a few shillings. Judiciously used, it will enable you to repeat the labours of those illustrious men whose names are intimately associated with microscopic anatomy. And it will open up a means of enjoying the book of Nature, that otherwise must have been a sealed volume.

Figure I. represents the instrument complete, and arranged in working order. Its stand is of wood, forming, when closed, a box of six inches square, and of the same height, made of mahogany three-eighths of an inch thick. Two sides are hinged, the nearer one so that it can be slipped off; this

FIG I



has spaces cut in it to receive the mirror, lens-holder, and lenses. The instrument can thus be used with transmitted light for transparent objects. In the centre of the lower side is fixed a pin of wood, F, three-eighths of an inch in diameter, and half an inch long, to carry a mirror (Fig. VII.), which may be mounted in the usual manner, with a tubular stem to slip over the plug; this will enable it to be turned in any direction. The upper part, or stage, has an opening in the centre two inches in diameter. This space may be closed with a piece fitted from the inside, and a flush handle, as seen in Fig. II., and in the section, Fig. V. It is held in its place by two brass tongues, *a a*. These are received into two slits, and lock by a slight rotation of the handle.

Fig. I., A and *x*, shows the hollow pillar, half an inch in diameter and five inches long, having a piece of sheet brass soldered to it at three-eighths of an inch from the end. In this oblong piece may be drilled two or more holes, through which to screw it to the under surface of the stage, in which must be bored a hole to allow the brass tube to come through it flush with the upper surface. Into this hollow tube may be fitted a rod (Fig. I., B), which must be made to work easily, without giving it too much play, and on this, from end to end, must be cut two V grooves, as shown in Fig. III., B; these will answer the purpose of a rack, and are more easily made. In lieu of a pinion, with leaves, a piece of steel may be turned up, with two ridges corresponding to the two grooves, and made to work therein in the usual way. One end of the pinion must be filed square, to receive a milled head (Fig. III., E) for adjusting the height of the arm carrying the lenses. This arm (Fig. I., C) is to be attached to the grooved rod at the upper end by a large flat-headed screw, D, which, passing through a slit cut in its length, will permit every adjustment to be made which in practice will be found necessary. It has a circle at one end, into which the lenses are dropped; this will be found preferable to screwing in, as it admits of them being readily changed.

It now remains for us only to add the lenses (Fig. IV.), which may be procured of any optician for a shilling each. Their focal lengths should be two inches, one inch, and half an inch, fitted so that they may be used singly or in combination.

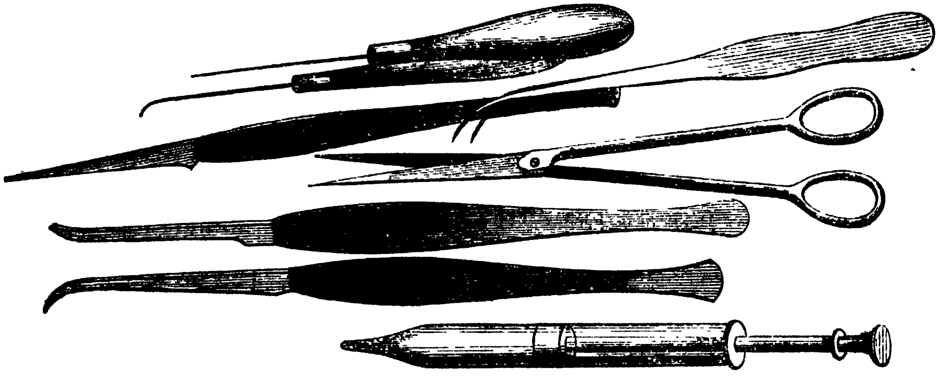
We must not omit the means for insuring a good light, without which little can be done. First, then, we must have a condenser, a plano-convex lens of four-inch focus, fitted as in Fig. I., G. This, attached to the upper part of the stage in front by a pin, will serve our purpose most admirably, and will throw a reflection upon the subject on which we may be working, if placed with its flat surface towards the lamp. As a source of light there can be nothing better than the small paraffine lamp, which may be purchased for some two or three shillings.

We must now address our few remaining remarks to the accessories, which are indispensable, and which, with few exceptions, can be manufactured at home. Of those that must be purchased, we will write, first, a pair of fine scissors, with long bows and sharp points, three scalpels, of the pattern figured, and a pair of fine-curved forceps; these must all have the most careful usage, and must be well wiped with wash-leather after use, to prevent rusting. Of those that remain, we may be our own makers.

I know of no more useful tools for our purpose than those which can be fashioned from needles, of which you should have several pairs, both straight and curved, fitted into handles; the latter may be made by warming a needle, and bending it to the required shape, and then rehardening and tempering it. A small glass syringe, and a few pieces of fine glass-tubing, will be of great service in washing specimens, or, what is still better, a washing-bottle (Fig. VI.), by which you can project a stream of water on your object through the tube, by blowing through the elastic tube, A.

Lastly, a glass trough, three inches square and one inch deep. To construct this, proceed as follows:—Take four microscopic glass-slides, and heating a piece of marine glue in a gas-flame, cover the ground edges with it. When all have been so prepared, slightly warm the glue, and stick the four sides together in the position you desire them eventually to occupy. Proceed in the same way to put a layer of glue on the square piece intended to form the bottom, having it cut a little larger than is necessary to cover the edges of the four sides. This done, arrange your square frame on the base, and put the whole for a few minutes into a warm oven on a piece of wood; let it remain just long enough to make the cement flow equally, when it is ready for removal, and, if gradually cooled, will be found perfect, and, if neatly made, will do no discredit to its maker. After cleaning off the superfluous cement, it will require to have the inner surface of its base coated with a layer of wax and rosin in equal parts, melted together and poured in just warm. This will admit objects being pinned out upon it for dissection, and will keep them below the surface of the water, with which they must be covered before we commence our researches.

With these at your command, my reader, you are in a position to make your first venture in the wide sea of science. And as you traverse its wondrous surface, you will be charmed with the islets that stud its bosom like gems in an emerald setting. Fresh wonders will unfold themselves to your eyes; you will learn lessons of life, and gain a knowledge of structure and creation that hitherto you have been in ignorance of, and you will see how vast are the resources of Nature in meeting the various wants of her progeny in the varied situations which they are destined to inhabit.



Hull. THOMAS ROWNEY.

HYDRA TUBA.

A STUDY FOR THE AQUARIUM.

EVERY seaside visitor, who has paid any attention to marine zoology, has no doubt either seen or heard of that remarkable phenomenon, the phosphorescence of the sea. It is attributed to various causes, but there is now very little question that it is generally produced by swarms of certain tenants of the ocean, and, among these, the greatest contributors to the luminous display are those marvellous productions of Nature, the *Medusæ*, better known by the less euphonius name sea-blubbers. We propose selecting one of these, the *Medusa minutissima* of Baster, and the *Medusa bifida* of Dalyell, and endeavouring to describe the strange forms which it successively assumes, and the remarkable properties with which it is endowed, before arriving at its perfect state.

The name *Hydra tuba* is applied to several distinct animals very closely resembling each other; so closely that it is difficult to classify them. Each of these may be characterized, partly, by minute differences in shape and mode of change, and partly the species of *Medusa* into which it is transformed. But as very few *Medusæ* have been traced from their original hydraform state, the difficulty of classifying these *Hydræ* still exists, and the group of specifically distinct animals is still designated by the one name, *Hydra tuba*. For the sake of convenience, however, we shall in the present paper apply the term, not to the group, but to the early or hydra form of *Medusa bifida*. *Hydra* simply implies the reproductive power when artificially divided, and under the term is included many species, if not genera. The *Hydræ* proper are found only in fresh-water, though the name, for want of a better, has been generally applied likewise to *H. tuba*, an inhabitant of the sea, so that, notwithstanding the similarity of name, form, and habits that exists between *H. tuba* and the genus *Hydra*, *H. tuba* is to be considered not a *Hydra*, but an *Acalepha* (sea-nettle or medusa).

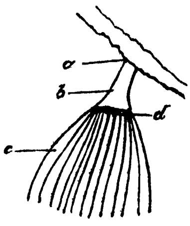


Fig. 1.

The *H. tuba*, or trumpet polype, generally occurs in large colonies, suspended from the sides of rocks in deep water, by a base or foot (*a*, Fig. 1). The body (*b*, Fig. 1) of a healthy specimen, in full expansion, is more or less trumpet-shaped; but it sometimes assumes the shape of a hand-bell (Fig. 2), and sometimes that of a cone, and is composed of a fleshy, granular substance, which, under the microscope, is seen to be cellular. To this body the tentacles are attached (*c*, Fig. 1), their number varying from four to thirty-two, according to the age and size of the specimen. They are beset with cilia, and are situated round the circumference of the disc, the centre of which is occupied by the mouth raised on a somewhat conical-shaped protuberance (*d*, Fig. 1).

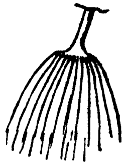


Fig. 2.

Suspended by the foot, and with tentacles elongated to such a degree as to have a tenuity equal to that of a gossamer spider's thread, the *Hydra* has all the appearance of an inanimate object, for the closest inspection can detect few other signs of life beyond the sudden contraction or gradual elongation of a tentacle. Although so inactive, it is on the eager watch for prey; and it is far from being the harmless and feeble creature it appears; for, should a cyclops (a small crustacean belonging to the class *Entomostraca*) knock against those filmy tentacles, it is seized with a convulsive and energetic clutch, and if the *Hydra* obtains a fair hold, which it sometimes fails to do, the struggles of the victim are useless; the tentacles lift it up to the mouth, and through that aperture it is introduced into the stomach, shell and all. The stomach, if such it can be called, is to all appearance little more than a sac or cavity occupying the whole of the internal portion of the animal, stretching to the very base, where the food can be seen through the semi-transparent skin, when the *Hydra* gorges itself to repletion. However simple this stomach may appear, it is capable of digesting or assimilating a wider range of substances than the stomachs of animals higher in the scale of creation. To suit such a stomach the voracity of the *Hydra* is extreme, but at the same time it is capable of sustaining an abstinence from food for a considerable period, the effects of which is seen in the slight meagreness and fading of colour which accompany it. After feeding, the *Hydra* presents quite a different appearance to that above described. The tentacles contract and become almost invisible; the body alone is seen, looking like a drop of some viscous fluid just about to fall; but this appearance is very unusual; generally it is more like that shown in Fig. 3. So protean is it in its form at different periods, that naturalists have been mistaken as to its identity, and have given it various names, as *H. gelatinosa*, *H. strobila*, and *H. tuba*.

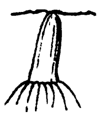


FIG. 3.

Full-sized specimens average rather more than two inches in length, measuring from the base to the tip of the tentacles; the body being about five lines, and the tentacles about twenty. The colour is white, in the older specimens occasionally acquiring a yellow tinge; but this, as also the rate of growth, appears to vary according to the quantity and perhaps quality of food.

Like the fresh-water *Hydræ*, *H. tuba* can be cut up into pieces with no material injury. Dalyell cut *H. tuba* into three or four pieces, and Trembley has cut *H. viridis* into forty. Each piece continued to live, and soon assumed the form and faculties of a perfect *Hydra*, which was itself capable of being multiplied by the same artificial means. But the natural mode of reproduction is by gemmation. First of all, a slight protuberance rises on the side, which, in a few days, assumes the shape of a young *H. tuba*. There it is affixed, procuring its own food, and enjoying an apparently independent existence, until it is thrown off by a process of exfoliation, to obtain its living elsewhere. Frequently three or four may be seen sprouting from the side of a full-sized specimen, and these again may have other young ones sprouting from their sides, presenting a most singular phenomenon. Indeed, its power of propagating is altogether a curiosity, considering that *H. tuba* is an animal in an imperfect form. The *Hydra* produces young of its own form all the year round, but at a certain period of the year, from about Christmas to May, some of the full-grown ones cease to propagate thus. Their bodies lengthen, become wrinkled, and then annulated (Fig. 4). The tentacles suddenly disappear from their usual place, the rings gradually separate from each other, their edges display eight notched processes, the notches grow deeper as development proceeds, until eventually the rings look like so many saucers of an eight-rayed star shape piled one upon the other. The lowermost ring (*a*, Fig. 4) is the largest and most fully developed. Tentacles again appear between the first and second rings (*c*, Fig. 4), soon after which an oscillatory movement may be observed in the lowermost ring, by which movement the captive detaches itself from the others, and issues forth a free being, a thing of life, transparency, and beauty; a merry butterfly of the ocean—in short, a *Medusa*. In the same way each ring is launched forth as a *Medusa*, each to enjoy a separate existence, and each to reproduce its kind. The modes of reproduction are four, but the most common is by means of eggs. These eggs go through a few changes, first assuming the shape of a minute ball covered with cilia; then fixing, it elongates, and looks something like a *Rotifer;* in time throwing out arms, it gradually arrives at what may be called the mature state of *H. tuba;* the state which we started with. As the rings are thrown off as *Medusæ*, the uppermost ring (*b*, Fig. 4) gradually lengthens into

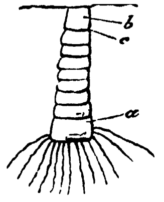


FIG. 4.—Showing the annulated appearance. *a*, lowermost ring.

a full-sized *Hydra*, but it sometimes happens that it does not increase in size, and after all the *Medusæ* have deserted it, their number averaging about ten, it remains stuck to the rock, without tentacles, and apparently inert; after some time, however, it sends out a lobe here and a lobe there, and eventually becomes transformed into one or more *Hydræ*. Each of these *Hydræ* will probably throw off *Medusæ* in the early part of spring, three or four years after.

To those of our readers who wish to verify these observations, or notice minuter details for themselves, the following remarks may be useful. The *H. tuba* is hardy, and may be kept for a considerable time in an aquarium. Dalyell kept one for six years; and Dr. T. S. Wright exhibited before the Royal Physical Society, Edinburgh, in March, 1858, a specimen which he had kept for four years, and which was then changing into the *Medusa* state. At that meeting he stated that Sars had kept a *Medusa*, produced from a *Hydra* kept in confinement for four months, when it proved to be *M. aurita*. Dalyell never succeeded in keeping them longer than sixty days, during which period they underwent no change. The *Hydra* is carnivorous, and may be fed with almost any kind of meat, but it is far more preferable to keep a stock of *Entomostracous*, or other small marine creatures, confined in the same vessel with the *Hydræ*, the meat only being resorted to when these are scarce. Lean alone should be given, as the fat, partially dissolving, rises to the top, forming a greasy coating there, and is very apt to taint the water. The pendent position should be allowed it, as this is clearly the natural one. Specimens may be obtained in several ways. To Londoners the most convenient and ready way is to buy them at Lloyd's. of Portland Road, where they may be had at about sixpence a dozen. By visitors to marine watering-places they may be sought for at the seaside, where a few may sometimes be found by searching pools among rocks, near low-water mark. On some parts of the coast the dredge will bring up a large number from deep water, on others but few or none; or, lastly, by obtaining the *Medusæ* themselves, which will generally deposit their eggs, if kept for a few days in an aquarium or other vessel in which weed is growing; but it is somewhat difficult to keep the *Hydræ* thus procured. The *Medusæ* in general may be caught with a net on calm evenings during the warmer months of the year, but *Medusa bifida* is only to be found in February, March, and April.

There is yet much to be discovered respecting these curious beings. There is no doubt that *M. bifida* is merely a transitional form, but we have seen no detailed account of its development to maturity. We have repeatedly seen it stated that it does undergo development, and becomes a *Medusa;* but what those developments are, or what *Medusa* it becomes, has not been stated. Sars has traced a *Medusa*, produced from *Hydra tuba*, to the form of *Medusa aurita*, but we have not seen his account of it. Others, again, say *H. tuba* is transformed into a *Cyanæa;* which is very probable, as we may get *Hydræ* from *Cyanæa*. The solving of these doubts will form subjects of interest for the attention of careful observers. A. Ramsay.

PRESERVATION OF BIRDS' EGGS.

Mr. A. D. Bartlett recently communicated to the Zoological Society the following method of preserving the eggs of rare birds during a voyage, or until an opportunity presented itself for getting them hatched:—Obtain animal gut of sufficient size to receive the eggs. Free the gut of fat, and cleanse it with powdered chalk. Pass the eggs into the gut, and tie it close to the shell at each end, and hang in a dry cool place. When quite dry, they may be packed in a box with any dry grain or seeds; the box to be turned bottom upwards occasionally.

TANKS FOR MARINE AQUARIA.

How in the season when the deep green of summer begins to wane, and the faintest tinge of autumnal orange appears like a blotch of lost sunshine on the landscape, do our thoughts revert to the vast, and unchangeable, and mysterious sea—

> "The glorious mirror, where the Almighty's form
> Glasses itself in tempests."

Unchangeable it is, though relatively ever changing; unchanging in its character, its office, and its plenitude of life, yet changing to us in its many moods of storm and calm, the glittering of its white foam in the sunshine, and the roar of its stormy waters in the awful darkness. We have never seen enough of the sea, for it never tires, though we visit the same bay, or the same creek, or the same breadth of snow-white beach, day after day; for the water has a life of its own, and its successive phases of playfulness, rolling grandeur, gentleness, and power, chain the mind to it; and while intellect strives to master some of the problems its phenomena suggest, the imagination and the fancy find therein inexhaustible poetry, indescribable beauty, and all the elements of fear, and joy, and wonder, and repose. Besides its own individual life, which compels us to invest it with some of the attributes of a creature gifted with purpose and volition, and capable of both love and hate to man, it holds another life within it, which the mind reaches after, which the hand reaches after, and, like another and a new creation, demands that man should stand in the midst and name the creatures. The fresh sea breeze—the calm expanse of blue, shading into mists flaked with distant sails on the horizon—the towering moorland and the grandeur of the cliffs, that show the scars of centuries of storm and battle—the music of the breakers, following in quick succession along the yellow strand, maintaining there a constant line of whitening foam—the vastness of the expanse, and the nothingness of man in the presence of it; —these do not suffice us as we stand upon the shore, yearning for knowledge after the creation that is hidden in the depths. There is one comfort: the conquest of the earth, given to man as a high and blessed privilege, extends to the sea also; it is to him a storehouse of wealth, to be sought in danger; and a storehouse of wisdom, to be explored in reverence; every one of its strange people offering a fresh lesson of the infinite goodness and infinite power of the Source of all things.

It is in this search that we betake ourselves to the aquarium, and find it of priceless value, because it places before us for daily observation, in the quiet retirement of our homes, things born and nurtured in the depth of great waters, and enables us, in places far away, still to believe that the sea is near us in the tiny imitation of it we have set up for our amusement. The marine aquarium ranks as much higher than the river aquarium as the sea itself transcends in glory the smallest of the hillside rivulets that hurries towards it as its final home. The range of subjects it embraces is a hundred-fold more extensive and wonderful than the river tank can ever be, and it provides occasion for the study of creatures that lie out of our ordinary path of observation, and which charm us by their novelty and beauty no less than by their structure and habits and several phases in the order of created life. Therefore the setting up and managing of a marine tank is a higher task than that of furnishing one with fluviatile subjects, and, like all other such enterprises, it is less easily accomplished, and calls for a larger exercise of judgment, and a more complete knowledge of first principles.

Happily for science, as well as for recreation, which of necessity is its proper attendant, the aquarium has come to have a definite meaning, and such a degree of certainty has been attained in its construction and management, that we need no longer speak of it as one of the hazardous enterprises of the enthusiastic student. Observation and experiment have in a few years settled most of those points about which there was at first so frequent a controversy, and the conditions of success may be stated in such a way as to insure to every beginner a safe and certain progress from the first.

An aquarium must be constructed in accordance with the use to which it is to be put, and therein are more matters for minute consideration than have been hitherto imagined. We now know, with a considerable degree of certainty, how the several tribes of animals and plants, that come before us for consideration, comport themselves in the confined space we would have them thrive in; and we know also, as the result of many sacrifices and disappointments, what degrees of light and heat affect the collection for better or worse, and, in fact, the risks attending the management of tanks has been reduced until we scarcely recognize their existence, but proceed in strict accordance with first principles, and accomplish the wished-for result, without feeling that any, even the least accident, is a necessity of the undertaking.

In the papers which have already appeared on fresh-water aquaria, I have not laid any great stress on the necessity of having tanks of a peculiar construction. In this higher department of the science the case is very different. Marine creatures are not so easily kept as river fishes, and the dimensions and forms of tanks are matters of the very first importance. For instance, we may have river tanks of any depth without fear of losses, because the supply of oxygen can be obtained more readily and more abundantly; and the tanks will bear more light than would be safe for marine vessels. Besides this, the inhabitants of river tanks are possessed of higher powers of locomotion, and can travel where they please within the limits of the vessel; but an *Actinia*, or star-fish, will be likely to travel to the bottom, and die there, for want of the life-sustaining element. Therefore it is important that whatever are the dimensions or forms of marine tanks, *they must be shallow*, and the object sought in determining their forms and sizes should be to expose as large a surface as possible to the atmosphere, consistent, of course, with the cubical contents of the tank. If they were made so shallow as to afford only just sufficient depth for the creatures to be quite immersed, it would be far safer than to proceed in the other direction, of giving more depth than needful. Take account of whatever aquarium failures you can remember amongst your friends, and you will invariably find that the vessels which caused the most trouble and gave the largest per centage of losses, were over a foot deep, and if we adopt for marine stock the rectangular vessels that were made in plenty when the aquarium first became popular vessels that were generally constructed with four sides of glass and a depth equal to half or more of their length—we shall consign to a tomb every item of marine stock committed to it. Instead of prescrvatories such tanks are sepulchres; river fishes may need no better, but marine zoophytes soon perish in them.

On this subject of the form of vessels, every aquarian must take a lesson from what has been accomplished by Mr. W. A. Lloyd, of Portland Road, Regent's Park. To him we are indebted for the invention of proper tanks, and the introduction of successive improvements in the method of management, which have given so great a degree of certainty to the practice. The thousands of animals kept by Mr. Lloyd in a perfect state of health and vigour, for sale, are in a series of shallow vessels of slate, through which there is a constant flow of water; the proportion of surface exposed is perhaps not less than one-sixteenth of the whole bulk of water in them, and thus there is a constant absorption of atmospheric air, and vegetation is not required at all. In the drawing-room aquaria, fitted up by the same persevering naturalist, the exposure of a large surface to the atmosphere is always aimed at as a first necessity, other aids coming in to still further insure a due aeration of the water. There is no occasion for a run through the tank, because the most complete aeration can be accomplished without it; but the imitation of a tidal flow is not only possible, but easy, and where it is adopted the number of specimens may be largely increased.

To smooth the way for beginners Mr. Lloyd has adopted a cheap form of shallow tank, which is here figured, in order that any readers, who are skilful in the construction of such things, may have before them a good model. They are made with bottom and three sides of slate, and the front of glass. Though they vary in proportions they may be generally described as eighteen

Rectangular Rock-pool Tank.

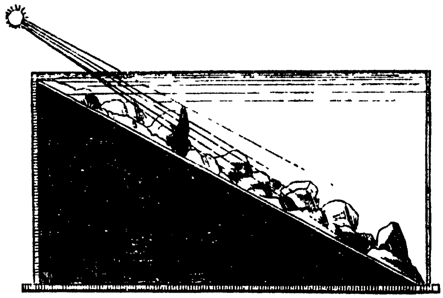
inches square and four inches deep. Now, you must have observed, if at all conversant with these pursuits, that *Actiniæ* that have been consigned to a glass or earthenware dish while the tank was being prepared for them, exhibited every sign of vigorous health. When transferred to the tank the trouble and vexation began; yet, perhaps, you never reflected that the dish was the best place for them, and the tank the worst. What is the lesson taught thereby? Plainly that your tank *was too deep;* they prospered in the vessel which held barely sufficient water to cover them, but began to decline, and ultimately perished, in that which by its very depth appeared more like their proper home. True, the sea is deep, and true also that most of the creatures kept in tanks are from its shores, where they are often laid bare by the receding tide, or with the merest film of water over them, to preserve them cool and moist in the sunshine. But there is another reason why we must not be led astray in supposing that deep vessels offer the best conditions for our purpose. The sea is too vast a mass in itself to bear comparison as to its internal economy with a tank containing but a few dozen, or even a few hundred, gallons of water. Its constant motion suffices to entangle and carry far down below the surface immense supplies of atmospheric air, and its abundant vegetation insures the most complete aeration of its waters. Therefore, for the pelagic or deep-sea life, shallow tanks are still the best, and if you are at this moment puzzled how to make a deep vessel answer for marine stock, give it up, and provide yourself with one of proper make and character. These shallow vessels, made expressly for beginners, may be imitated in an inexpensive way by means of a glass dish, an earthenware foot-bath, or any other vessel not metallic, of similar form and dimensions. As the appearance of the thing is, in many cases, all-important, it is with no small pleasure that I can bear testimony to the beautiful appearance of these shallow tanks when stocked with a suitable variety of zoophytes. The view from above is the best, for we then see the expanded rays directly, whereas from the front we generally have an oblique view, unless some considerate anguicoma or dianthus turns his face full upon us, away from the glare of light which the window admits upon him.

The very best and cheapest ready-made vessel in which to preserve a few sea anemones is a glass dish, such as is used in dairies for cream, or the glass soil-pan of a common fern-shade, as here figured.

Circular Glass Rock-pool Tank.

From this simplest of all forms of vessels let us proceed another step. The tanks with four sides of glass admit a vast deal too much light; the consequence is, that some of the inhabitants commit suicide, and the vegetation, instead of doing its work in an orderly way, becomes rampant and unmanageable. Instead of a velvet-like growth of minute *Algæ* on the rock-work, involved ropes of *Confervæ* appear, or, what is worse, the water becomes opaque with "green stuff;" there are more spores set free than can find resting-places, and they float in the liquid, and make it of the consistence of pea-soup. Light alone must not have all the blame, for heat is also a powerful agent to bring about such a state of things. It is evident, therefore, that the heavier the vessel is in bulk, proportioned to its size, the more slowly will it be affected by heat; a heavy non-conducting opaque material should largely predominate in the construction of the tank, and nothing has hitherto been found so suitable as slate. The lighter and more fully illuminated the vessel, the less is its value for marine purposes; it must be heavy, and but partially open to the effect of light, and then an equable temperature is obtained, and a more constantly pellucid state of the water. Mr. Warrington's name must have honourable mention here, as the inventor of the slope-back tank, which realizes the conditions of success more completely than has been accomplished by any and every other means.

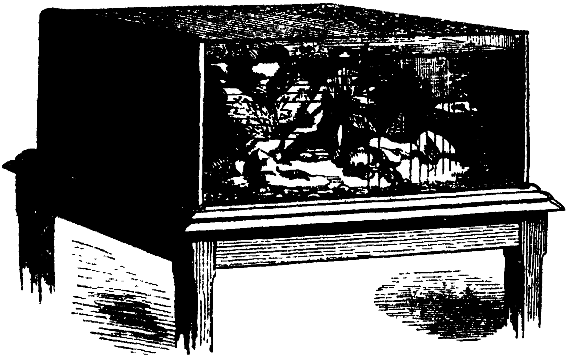
The object sought to be accomplished by this form of vessel is a closer imitation of the conditions under which marine animals exist in their native waters. *There* the light which reaches them is wholly vertical, or at least the laterally-refracted rays are but of small account. In the slope-back tank the back and ends are of an opaque material, and light is admitted from above only, so that the tank is in itself the closest possible imitation of a rock-pool, with the advantage of affording an uninterrupted view of the contents. The form in which these tanks were originally made has been improved upon, as shown in the annexed cut, and with these vessels I



Lloyd's Patent Water Chamber Tank

have had such unvaried success, that from my first adoption of them I have constantly recommended them as the best for marine purposes. It is true that able pens have denounced them as ugly and unmanageable, but the day of their disgrace is nearly over; many who opposed them are now glad to have their aid, after paying heavy penalties in the use of tanks made wholly of glass; and after the shallow square tanks and the glass pans, these are certainly the next in efficiency, and, so far from being inelegant, nothing in the way of aquaria can surpass or even equal the beauty of the scene they present when well stocked, the subdued light being in favour of the view rather than Were it otherwise the health of the inmates would be a sufficient compensation, for in a matter of this sort it would be absurd to advocate any form of vessel, however elegant, which did not fulfil the conditions essential to the preservation of the creatures.

Let us consider for a moment what are the advantages of this form. Owing to the slope of the back it can be fitted and unfitted more quickly than any other kind of vessel, except the little shallow ones already described. In fitting rock-work, not a particle of cement is needed; hence, instead of losing the whole stock two or three times over, as is the case sometimes when cement has been used, and has been supposed to be properly seasoned, the risk from that danger is reduced to *nil*. Any rough non-metallic mineral may



Patent Water Chamber Slope-back Tank.

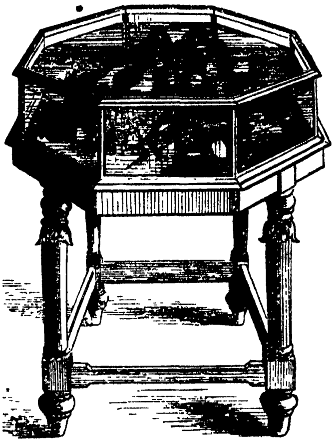
be piled upon the slope in a few minutes, tufts of *Algæ* inserted *à discrétion*, and removed again when they decay, without the smallest disturbance of the general furniture. Better still, the most beautiful and appropriate back-ground may be made up of old serpula, oyster, and other shells, blocks of coral, and such light rough *débris* as will be sure to accumulate in the hands of an aquarian. Oyster shells, incrusted with serpulæ, balanæ, and other small marine masons, add nothing to the weight of the vessel, yet serve all the purpose of heavy rock-work; and if the spontaneous vegetation so necessary to the success of the tank does not appear on them with sufficient profusion, a few pieces of mica-schist may be mixed with them and left alone, and there will soon be plenty.

Another advantage of these tanks is their strength. When properly made, they will last a lifetime without becoming leaky, which cannot be said of any tank having four sides of glass. Perhaps four-fifths of the glass tanks made and sold at the first start of the aquarium are now in lumber-rooms inhabited by spiders, and the majority of their owners have given up aquarian pursuits, under an impression that the construction of water-tight tanks is an impossibility. That the impression is an erroneous one the process of uniting the joints patented by Mr. Lloyd sufficiently disproves; but, on the old plan of letting the glass into a simple groove, the Warrington tank, having three sides of slate, can be made sufficiently strong to endure a lifetime. The amateur who constructs his own vessel must be on his guard against the folly of attempting to make it light: the heavier the better, consistent with neatness and soundness of the joints.

A still more important advantage of the slope-back tank is the equable temperature of the water within it. Even if the sun's rays be allowed to play on the back of the vessel—which they should not—there is so large a bulk of slate for them to heat before the water can be affected, that there are no sudden changes of temperature to destroy the lives of the inmates. The tanks of this sort are therefore essentially *cool*, and during the trying months of July and August marine animals will endure the heat with patience, when, in any vessel having glass sides, they would be perishing at the rate, perhaps, of half a dozen per diem.

But the improvements effected by Mr. Lloyd have rendered this form of vessel still more acceptable than it was originally. On the principle that the larger the bulk of water the greater the variety of creatures that may be preserved in it, Mr. Lloyd has adopted a form by which the triangular space under the sloping back is converted into a water-chamber, communicating with the space in front. Into this chamber none of the animals can find access, and in one sense the bulk of water it contains may be regarded as a reserve, the whole of which can be pumped into the tank proper whenever, by the death of an animal or other causes, the water there has become impure. A further advantage of the water-chamber, in addition to the increased resistance to changes of temperature, which the increased bulk of water offers, is the rapid restoration to purity which the water undergoes in it, and the obliteration in the course of a few hours of that peculiar malady of the marine tank, known as "pea-soup greenness," the result, generally, of the toofree admission of solar light. Should the tank become cloudy by the presence of an excess of microscopic sporules, the whole can be changed from the light to the dark chamber, and *vice versa* by the action of a small pump; and thus, in case of any accident, there is a reserve of fresh sea-water ready, without fetching or carrying, in the body of the tank itself. Being comparatively shallow as to other dimensions, there is a large surface exposed to the action of the atmosphere; and by adding a glass cover, to be raised or lowered by means of a cord and pulley, all the conditions of success are insured by the simplest possible arrangements.

For special purposes other forms of tanks must be used. It is not advisable, for instance, to associate together *Molluscs* and *Actiniæ*; and instead of the slope-back tank, which is unequalled for the latter, the former are most conveniently preserved in shallow octagon tanks, which are fitted with rock-work rising above the surface of the water, so as to allow the creatures to leave the water entirely, and scramble about on the rocks



Octagon Tank for Crustaceans.

above the surface. If a cover be needed to prevent escape, one of wire gauze, fitted on a moveable frame-work, would be the best. If a glass cover is used, it should be in two or more pieces, placed sufficiently far apart to admit air, and raised above the level of the edge of the tank at least a quarter of an inch, so that the air may circulate underneath it.

Those who are about to set up aquaria, or construct vessels for themselves, should consult the valuable "List of Whatever Relates to Aquaria," by W. Alford Lloyd, 19, Portland Road, Regent's Park, London, W. No keeper of an aquarium should be without it.

SHIRLEY HIBBERD.

GUANO UNDER THE MICROSCOPE.

DIATOMS, mounted as microscopic objects, are frequently sold singly, each preparation containing only one specimen. Occasionally, the liberal preparer will give you a group of from three to seven Diatoms, which he has carefully selected and laid on the glass slip in the position which shows them to the best advantage. With the rarer kinds, the amateur must often be content to possess only one specimen; and for display, for the pleasure of showing their intricate beauties to admiring friends, such picked and artistically disposed samples are extremely valuable. But for study and comparison, for the purpose of trying to make out what was the general form and anatomy of the living things that were made up of the extraordinary bodies which we call Diatoms, we greatly prefer a less artificial choice of objects, which allows us to examine them in a more natural condition, so to speak, although they may be, for the greater part, imperfect and broken, and, so far from being arranged in formal order, are merely thrown pell-mell upon the glass, so as to present themselves in any position in which chance may have placed them.

As instances of what is meant, Mr. Stevens has offered preparations of American earths and muds containing various Diatoms; M. Bourgogne, of Paris, three or four years back, published, if we may so express it, some mud from Cherbourg, which was rich, especially, in Biddulphias; he also obtained, from Ichaboe guano, a great quantity of circular Diatoms with highly coloured blue and purple central disks: in these last, however, there was no great variety of form. Very lately, Mr. Amadis, of Throgmorton Street, has extracted from some guano, given him by a customer, which came from Patos Island, California, a very remarkable and instructive assemblage of Diatoms. To the naked eye, they appear like a fine dust scattered over the surface of the magic circle, or as if an inquisitive miller's man had grasped the slip between his floury finger and thumb; but, under a power of 220 diameters, we have a galaxy of brilliant gems, a complete milky-way of Diatoms, little and big (by comparison), entire and in fragments. The field of view looks as if strewn with crystal articles that had been plundered at random from the curiosity-shops of some outlandish town, and then thrown down in a heap on the ground, to be sold for old glass after the handsomest things should be picked out and laid on one side. What first strike the view, are Triceratiums, three-cornered Diatoms perforated by cells, which are hexagonal, like those in a honeycomb; then, there are Coscinodiscuses, or sieve-disks, circular and more or less flat, all riddled with holes, some of the holes being so extremely minute as to require the higher powers of the instrument to render them clearly visible. The positions, also, of the Diatoms invest them with greater interest. We have a much better idea of the construction of a footstool, if we see footstools lying about topsy-turvy and on one side, as well as standing steadily and respectably in their usual positions; exactly so with regard to the Biddulphias and other curious things contained in this guano. Besides Diatoms proper, there are sponge spicules, transparent crowns of thorns, circular diadems, and what would serve as tasty patterns for a novel style of buckle. These last are probably portions of the outer coat or shell of some small creature of the sea-urchin family. In short, the observer, who is able to identify and name all the objects which are exhibited by this Californian guano, will have made some considerable acquaintance with the puzzling objects which lie on the borderland between vegetable and animal life.

E. D.

SOME OBSERVATIONS ON FORCE.

The subject of force is one which is fundamental to a correct acquaintance with the physical sciences, although so imperfectly understood, and which has lately had the attention of many philosophers.

In the physical sciences causes determine force or effort, and is therefore productive of change, inasmuch as it cannot be allowed that any sequence is, although every sequence or effect is a cause, a first cause. Dr. Brown, in his work on cause and effect, as Sir J. F. W. Herschel truly remarks (*Treatise on Astronomy*, "Cabinet Cyclopædia"), altogether neglects the consideration of effort, than which no mistake could be worse, and which, of course, sullies the whole volume, otherwise containing much valuable metaphysical reasoning. This mistake is a very remarkable one, and shows the necessity of appealing to physical facts before yielding to any metaphysical deduction, however logical it may appear.

It is not evident that matter could be perceived by us were it not for its forces; nevertheless, I do not contend for the identity of the two things, as some who think differently may. I think that this may be illustrated by the attraction of cohesion, where we meet with a universal power, upon the removal of which it is not evident that we could detect matter, even supposing it capable of existing apart from it, which I do not think I am forced to grant. It cannot be proved that force is tantamount to motion. To suppose this is strangely to confuse cause and sequence or effect, and the absurdity appears more strikingly by looking at the converse assertion—motion is identical with force; a doctrine which little consideration will overturn. It is true that force cannot, of course, dynamically exist apart from motion, which appears to be its vehicle; but this by no means proves that the two things are the same. It may as logically be said, that because the atmosphere cannot exist apart from space, it is space. We can conceive of motion existing without force, proving that the two things are not identical.

With regard to the creation of force, I consider it absurd to suppose that we can do no more than impart it. Dynamic force is every moment brought into existence. This is seen in the phenomenon of momentum, or that of direct pressure when imparted by human agency, inasmuch as the imparting agent loses none by the action. It is true that we are ignorant of the mode in which the force of momentum is brought into existence, but this in no way casts a doubt upon the supposition of its creation; with respect to which I argue that there can be no impartation, for when this is the case there must be loss. The mechanical experiment with the hanging balls is a satisfactory proof of this.

The conservation of force is at present a necessity. Neither statical nor dynamical force can be destroyed. Every body, except in circumstances where the force of gravity is counterbalanced, must exercise downward pressure; here is the perpetual exertion of force, which, except in the condition contemplated, cannot be destroyed; and even when this is the case, we have the cohesive force to get rid of, if we would rob matter of all its forces, even as far as we are acquainted with them, which knowledge is probably very imperfect. It is very clear, that without cohesive attraction there could not be that of gravity; and I would again urge the impossibility of matter existing without the former of these exertions. It is the *sine qua non* of its existence; and yet, almost paradoxical fact, not it. Whether or not statical force exists apart from any motion, is a question of no easy solution, and which I shall not here take upon me to decide.

Logic and metaphysics sometimes oppose the conclusions of physical science, but probability always sides with the latter, inasmuch as the former sciences are more apt to be perverted, and have most frequently been the creators of absurdities. It is evident that every effect is also a cause, and it is also true that effect is the result, and by no means the manifestation, of cause. We know nothing of first cause, and merely perceive a series of effects.

J. A. DAVIES.

METEOROLOGY OF JULY.

FROM OBSERVATIONS AT HIGHFIELD HOUSE OBSERVATORY.

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Year.	Greatest Heat. Degrees.	Greatest Cold. Degrees.	Range of Temperature.	Amount of Rain. Inches.
1842	78·0	45·0	33·0	—
1843	77·0	42·5	34·5	1·8
1844	88·0	45·0	43·0	1·4
1845	78·5	40·0	38·5	3·7
1846	87·0	50·4	36·6	2·8
1847	77·0	47·0	30·0	0·7
1848	84·8	40·3	44·5	3·4
1849	85·0	39·5	45·5	2·3
1850	87·3	37·8	49·5	4·1
1851	82·5	40·0	42·5	3·4
1852	91·0	49·5	41·5	2·7
1853	79·0	42·0	37·0	2·9
1854	86·0	43·2	42·8	2·1
1855	83·5	45·2	38·3	4·6
1856	82·0	36·3	45·7	2·6
1857	80·0	45·0	35·0	1·7
1858	86·8	38·8	48·0	1·0
1859	89·5	45·6	43·9	0·7

The greatest heat in the shade reached 91·0° in 1852, and only 77·0° in 1843 and 1847, 78·0° in 1842, 78½° in 1845, and 79·0° in 1853, giving a range of 14·0° in greatest heat for July during the past eighteen years. The temperature was high in 1844, 1846, 1850, 1852, 1854, 1858, and 1859, and low in 1842, 1843, 1845, 1847, 1853, and 1857.

The greatest cold was as low as 36·3° in 1856, 37·8° in 1850, 38·8° in 1858, and 39·5° in 1849, and never below 50·4° in 1846, giving a range of 14·1° in greatest cold for July during the past eighteen years. The minimum temperature was low in 1845, 1848, 1849, 1850, 1851, 1856, and 1858, and high in 1846 and 1852.

The monthly range of temperature was as much as 49·5° in 1850, 48·0° in 1858, and only 30·0° in 1847, and 33·0° in 1842, the difference in the range being 19·5°, and the range of temperature for July in the last eighteen years being from 36·3° to 91·0°, a difference of 54·7°.

Only three-quarters of an inch of rain fell in July in 1847 and 1859, and as much as 4·6 inches in 1855, and 4·1 inches in 1850, giving a range of 3·4 inches for July during the last seventeen years. In three years the amount did not exceed an inch, in six years it did not exceed two inches, and in twelve years it did not exceed three inches, whilst in five years it ranged between three inches and a half and four inches and a-half; the mean amount of rain for July being two inches and a-half.

July is usually a hot month, and subject to thunder-storms.

E. J. Lowe.

—o—

ASTRONOMICAL OBSERVATIONS FOR JULY, 1860.

—o—

The Sun is in the constellation of Cancer until the 22nd, when he moves into that of Leo. He is north of the equator throughout July, and reaches his greatest distance from the earth on the evening of the 1st.

The Sun is partially eclipsed in England on the 18th, and totally so in a certain portion of North America, across Spain from the Biscay side, about Bilbao and Santander to the opposite shore (Mediterranean), about Valencia, on the island of Ivica, and across Algeria to the Red Sea. (For a full description, see the article, "Total Eclipse of July 18, 1860," page 16, vol. ii.) He rises in London on the 1st at 3h. 49m., on the 10th at 3h. 57m., on the 20th at 4h. 9m., and on the 30th at 4h. 22m., setting in London on the 1st at 8h. 18m., on the 10th at 8h. 13m., on the 20th at 8h. 3m., and on the 30th at 7h. 49m. In Dublin he rises on the 1st eleven minutes earlier, on the 13th eight minutes, and on the 29th five minutes earlier than in London; setting in Dublin on the 4th ten minutes later, on the 14th nine minutes, and on the 30th seven minutes later than in London. At Edinburgh he rises on the 11th twenty-five minutes earlier, and on the 21st twenty-three minutes earlier than in London; setting on the 22nd twenty-one minutes later than in London.

The Sun reaches the meridian on the 1st at 12h. 3m. 33s.; on the 10th at 12h. 5m. 3s.; on the 20th at 12h. 6m. 3s., and on the 30th at 12h. 6m. 8s. The equation of time on the 1st being 3m. 33s., on the 10th, 5m. 3s., on the 20th, 6m. 3s., and on the 30th, 6m. 8s.

Day breaks on the 23rd at 12h. 40m. a.m.

Twilight ends on the 31st at 10h. 40m. p.m.

Length of day on the 9th, 16h. 18m.

The Moon is full on the 3rd at 4h. 7m a.m.

New Moon on the 18th at 2h. 19m. p.m.

The Moon is at her greatest distance from the Earth on the 8th, and nearest to our globe on the 20th.

Mercury is in Cancer, passing into Leo at the end of the month, and is at his greatest eastern elongation on the 13th, and is stationary on the 26th. His diameter is 6¼″ on the 1st, and 9½″ on the 26th. He sets on the 9th at 9h. 27m. p.m., and on the 29th at 8h. 4m.

Venus is very bright, but is rapidly ceasing to be an evening star, and at the close of the month is a morning star, and still increasing in brilliancy; her diameter on the 19th is 56¾″. She is in Cancer at the beginning, and in Gemini at the end of the month. She rises on the 29th at 3h. 35m. a.m., and sets on the 9th at 8h. 31m. p.m.

Mars has a circular disc of 21″ at the beginning, and 23″ at the close of the month. He is situated on the borders of Sagittarius and Capricornus, arriving in opposition on the 17th, but, owing to his position being scarcely 10° above the horizon, is unfavourably situated for observation. He rises on the 9th at 9h. 19m. p.m., and sets on the 29th at 2h. 30m. a.m.

Jupiter is in Cancer, setting soon after the Sun, and is therefore invisible to the naked eye. He is in conjunction with the Sun on the 29th. He sets on the 9th at 9h. 1m. p.m., and on the 19th at 8h. 27m. p.m.

Saturn is in Leo, and also invisible to the naked eye. He sets on the 9th at 9h. 57m. p.m., and on the 29th at 8h. 43m. p.m.

Uranus is in Taurus, and becomes visible at the close of the month.

The Eclipses of Jupiter's Moons are invisible during the month.

There are no Occultations of Stars by the Moon larger than the 6th magnitude.

There will be a partial, yet large eclipse of the Sun on July 18th (see Fig. 3, p. 18 of this work, vol. ii.).

The Variable Star Algol (in Perseus).—Times of *least light* (Greenwich time) during the evening of the 21st, at 9h. 40m. p.m.

E. J. Lowe.

THINGS OF THE SEASON—JULY.

FOR VARIOUS LOCALITIES OF GREAT BRITAIN.

—o—

Birds Arriving and Departing.—None.

Insects.—Acridia varia and bipunctata, Argynnis aglaia and paphia, Apatura iris, Balaninus nucum, Berosus globosus, Clisiocampa neustria, Colymbetis vitreus and ater, Clytus Arietis and glaber, Dyticus dimidiatus, Hipparchia Cassiope, Semele, Iphis, Davus, Hero and Arcanius, Hylobius abietis, Lycæna hippothoe, Limenitis camilla, Lithosia complana, Liparus Anglicanus and Germanicus, Odontonyx rotundatis, Platycerus caraboides, Prionus coriarius, Telephorus cyaneus, Tillus elongatus, Common, Red, and British Wasp, Hornet, Large Tortoiseshell Peacock, Purple Hairstreak, Large Blue, Chalk-hill Blue, Small Skipper, Pale Blue, Silver-studded Blue, Lunar Hornet-moth, Wood Leopard, Barred Tree Lackey, Drinker, Vapourer, Yellow-tail, Golden Y Moth.

Wild Plants.—Enchanters and Woody Nightshade, Water Speedwell, Bladderwort, Clary, Yellow Iris, Bull and Club Rush, Bearded Darnel, Fuller's Teasel, Yellow Bedstraw, Ladies' Mantle, Potamogeton Species, Yellow Loosestrife, Bog Pimpernel, Dortmann's Lobelia, Verbascum species, Henbane, Centaury, Saltwort, Field Gentian, Fool's Parsley, Water Parsnip, Water Dropwort, Common Thrift, Sea Lavender, Common Flax, Round and Long-leaved Sundew, Water Purslane, Water Plantain, Willow Herb, Cross-leaved; and Five-leaved Heath, Persicaria, Winter Green, Bladder Campion, Purple Sandwort, Sedum species, Cerastium aquaticum, Spergula subulata and nodosa, Rubus species, Nuphar and Nymphæa species, Water Soldier, Vervain, Horehound, Wild Thyme, Wild Marjoram, Antirrhinum species, Dyer's Woad, Musk Mallow, Althæa species, Sea Pea, Meadow Vetchling, Milk Vetch.

Mr. Noteworthy's Corner.

Optical Appearances in Butterflies' Eyes.—If a butterfly (of any smooth-eyed species, which shows clearer results) be held in bright light, and the eye closely examined, there will be seen a curious group of darkish spots inside the brilliant eye, which are arranged round each other in regular order, each one being bordered by six others, thus (Fig. 1), and the edges of the field of view show other dots just coming in sight. These are very pretty objects, and the writer has often wondered how they were produced. He submits the following explanation as his solution, hoping another or better will be given by any one who may have thought about it. On closer examination with a low magnifying power, these dots are found to be regular hexagons, with an interval between of about their own breadth, or rather less (Fig 2). Now, with a high magnifying power, the surface of the eye is found to be divided with very minute hexagons, exactly of the same shape, but without any interval between, the surface being a wonderful assemblage of minute lenses, of regular curvature (Fig 3), all joining to form one large lens, the cornea of the eye. It seems, then, that the appearances inside may probably be caused by the reflection of these hexagons on the retina of the butterfly's eye, being then seen by the observer much magnified, by the transparent eye acting as a lens on the side next him. And to account for the intervals separating the hexagons, as seen by him, which do not occur in the pattern actually on the cornea, it may be easily shown that the course of the rays passing through such a set of hexagonal lenses would, by converging after entering the eye, tend to leave at distances nearer or further than their focal length, just such an arrangement of alternate hexagonal dark and light as is actually seen (Fig 4). This, then, is my attempt to account for these spots—that they are an image of the

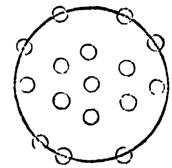


Fig. 1.

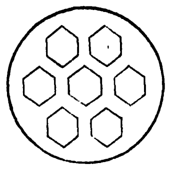


Fig. 2.

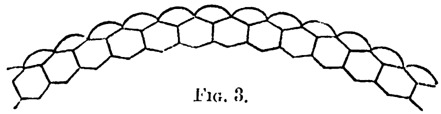


Fig. 3.

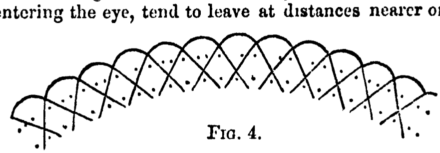


Fig. 4.

pattern on the cornea, first reflected on the retina, and then seen magnified highly by the action of the globular eye itself. And this occurs in whatever position the eye is held in.—C. HOPE ROBERTSON.

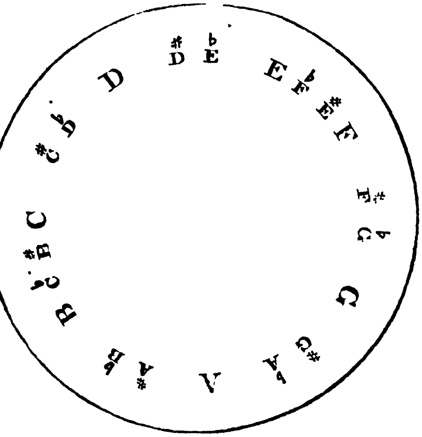
A NEW COMET was discovered by M. Rumker, at Hamburg, on the 17th of April. On the following evening the comet was seen at Altona; it is described as being very faint.

Positions.

	R.A.	Decl.
April 17..11h. 6m. H.M.T...	2h. 40m. 20s...	+ 48° 21′
" 18.. 9h. 34m. A.M.T...	2h. 50m. 13s...	+ 48° 50′

C.

A MUSICAL SCALE INDEX.—The following diagrams represent a simple apparatus of cardboard, contrived for the purpose of showing, in the plainest manner, the major diatonic scale for every position of the key-note. Fig. 1 shows the relative situation of every semitone of the chromatic scale, arranged in a circle having its circumference divided into thirty-one



1.—The Chromatic Scale.

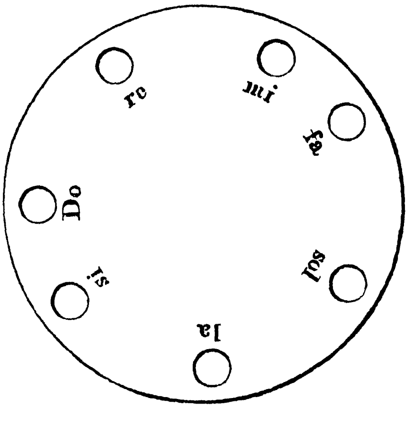
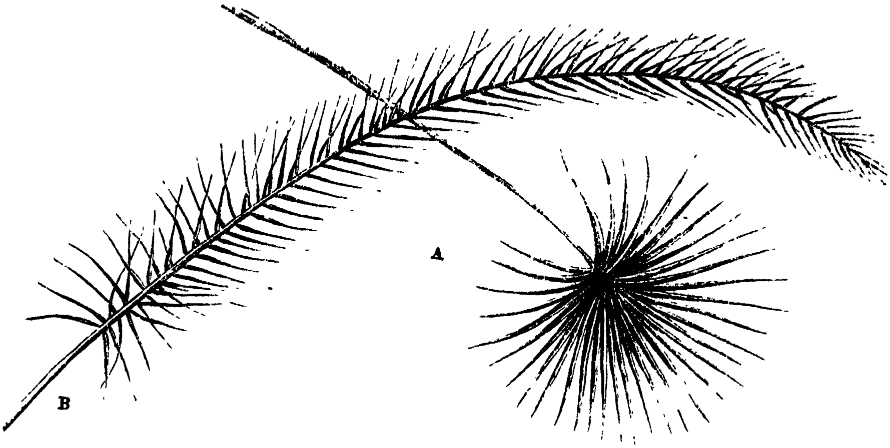


FIG. 2.—The Diatonic Scale (Major).

equal parts; two of which are taken for a minor semitone (a sharp or a flat); three for a major semitone; and five for a tone. Fig. 2 is an arrangement, on the same principle, of seven apertures, marked Do, re, mi, etc., and represents the major scale. If the latter diagram is laid over the former, and the two joined together by a pin or thread passing through the centre of each, and if the aperture marked Do (the key-note of the scale) is placed over any note of the chromatic scale, the other notes in the key selected will show themselves through the remaining openings; at least, unless the key should happen to be one requiring a double sharp or flat—the key of D sharp, for instance—in which case blanks appear. Four varieties of minor scales are obtained by making re, mi, la, and si starting points, or key-notes, instead of Do. F. W.

WHAT ARE THE "XANTHIDIA" IN FLINT?—The curious microscopic fossils found in flint, termed by Ehrenberg *Xanthidia*, are generally supposed to be the sporangia or spore-cases of some fossil species o *Desmidiæ*, principally, I believe, from the close resemblance which they bear to the stellate bodies produced by the conjugation of *Cosmarium Botrytis* and some other recent species. To this view there are, it seems to me, two very formidable objections, and, though these are so obvious that I do not see how they can have escaped the notice of any one who has ever had his attention directed to the subject, I do not remember ever to have seen them answered. In the first place, if the common view be true, is it not strange that, while the sporangia are so plentiful, the plants themselves have never yet been detected. Yet the sporangia must have been much less numerous than the parent plants, for each sporangium implies the existence of two parents, and produces a numerous brood of offspring, and, besides this, the plant multiplies itself also in other ways, viz., by duplicative subdivision and by the formation of motile "gonidia," or zoospores, curious little bodies formed within the parent plant, and moving themselves by means of cilia. There seems to be no satisfactory reason to be assigned why the sporangia should be more durable or more easily preserved by silicification than the plants from which they were produced, and, though the empty frond of a *Cosmarium* is not a very conspicuous object, there would be little difficulty in detecting it if it existed in a flint. I have, however, examined many chips of flint in which *Xanthidia* occurred, without finding any object at all resembling any of the *Desmidiæ*. But my second objection is by far the most formidable. The recent *Desmidiæ* are purely freshwater plants; no species has ever been found in the sea. Now, the flints of the chalk in which *Xanthidia* abound are of marine origin, and the same flint in which they occur often contains also a marine shell, coral, or sponge. Indeed, so commonly is this the case that Dr. Mantell suggested that the *Xanthidia* might be the reproductive gemmules of the sponges, in company with which they are so often found.—C. H. C.



A, a leaf of the Great West Indian Fan Palm; B, a young leaf of the Date Palm, showing the two typical forms of foliage among the family of Palms.

AMONG THE PALM-TREES.

I VENTURE boldly to affirm what may at first sight appear somewhat paradoxical, that is, that London is the most fitting place for the residence of a naturalist; that in the noisy, bustling city he has greater opportunities for the study of Nature than his brother student who lives in the recesses of the forest, beside the dashing waterfall, amid the time-worn mountains, or who takes up his abode upon the wave-washed shore. In London he can, without any of the toil or danger of travelling in far away and unhealthy regions, quietly examine their products, whether animal, vegetable, or mineral, in the various museums, botanical and zoological gardens, with which the metropolis abounds. It would need a whole lifetime to be spent in hurrying from one corner of the earth to another, and even then we could not find for ourselves one-tenth part of the objects which are here daily exhibited, gratuitously, within a few minutes' walk of our own fireside. True, we cannot generally, under these circumstances, watch the habits of the animal world, or observe the instincts which guide their actions—here we must fall back upon the writings of others; but we can at least see how well fitted they are for their various modes of life, how armed for combat, or provided with the means of escaping their enemies. On the other hand, if mineralogy be our study, or the fossil records of those races which countless ages ago inhabited this globe of ours, the advantage then is on the side of the Londoner, for he can at his leisure compare the products of all countries and of all periods. And if the vegetable world attracts his peculiar attention, the advantage is still on his side, as we shall presently see.

Come with me; jump on to the deck of the steam-boat, or into the railway-carriage, and in less than an hour I will land you among the vegetable glories of any quarter of the globe you please to select. You shall inhale the odours of the Spice Islands, revel amid the luxuriant vegetation of the tropics, or have spread before you the floral gems which adorn the snowy mountain peak or the far away and wintry north. Here, in the botanical gardens of Kew, you may study the graceful family of ferns collected from every region under heaven; you may ramble among the "golden wattles" and "blue gum-trees" which overshadow the hut of the Australian colonist; you may observe the curious forms assumed by the different kinds of American aloe, or the still more grotesque appearance of the cacti; the epiphytal orchids which hang high above the heads of those who force their way through tropical jungles, are here brought down and placed within your reach. Would you wander among the heaths of the Cape, with their amazingly varied and wax-like flowers, or stroll in groves of Himalayan rhododendrons, with their bouquets of gorgeously-coloured blossoms, they too are here.

> "Obedient sails, from realms unfurrow'd, bring,
> For Kew, the unnam'd progeny of Spring."

Amid such profusion of vegetable wealth, where shall we choose? Let us wander for a time in this forest of palm-trees.

Do not fancy that we shall find here only a few puny specimens of these princes of the vegetable world; they are here by hundreds, and many of them have already attained such proportions, that they furnish us with a very good idea of the appearance they present in their fatherland. Many of them are planted beneath a glass dome some sixty feet in height, where an artificial climate is produced, which might almost induce them to believe they are still luxuriating in their native clime. Some of them, a kind of cocoa-nut for example, shoot up with a clear, branchless, leafless stem of thirty feet or more, and then throw out a crown of gracefully drooping leaves, each one of which would be a burden for a man, and twenty, or five-and-twenty feet long. Our preconceived ideas of palms receive one or two severe shocks, however, for we find that they do not all of them produce waving, plume-like leaves at the apex of tall slender stems, like the *Cocos plumosa*, which we have just described, or like the toddy palm (*Caryota urens*) growing beside it. In fact, they vary greatly in their way of growth. Some make no stem at all, but throw up their flower-shoots from the centre of a tuft of leaves springing at once from the ground. Some are even climbing plants, making stems which, when fully grown, will be three or four hundred feet long, which, like a gigantic bramble, will, by means of its hooked leaves, climb from tree to tree. Cane is the stem of such an one—a species of Calamus, common in the East Indies—which is cut into lengths and imported into this country for a variety of uses. Then there are some palms, slender as reeds, which flower and bear fruit when not taller than a man. Others are found whose stems are slender, both above and below, but in the middle swell out like a barrel. The stems of some of them are as smooth as those of the birch in our plantations, while others are shaggy with the rough elastic fibres which we turn to account in the making of brooms, and others again are armed with long and formidable spines, hard, black, and shining, and more sharply pointed than the finest needles.* Their leaves, too, present two different types of form, one division having feather-shaped leaves, that is, a row of leaflets along each side of the leaf-stem (pinnate); while the other kind have fan-shaped (flabellate) leaves. Palms differ widely as to their fruit also; those seeds upon the great fan palm (*Sabal umbraculifera*), which hang above your head, are not much larger than peas, and yet you will recollect how large the cocoa-nut grows, and there are some which are three or four times as large as it. In quality they differ even more than in size, for while whole nations subsist for months together almost entirely upon the fruit of the date palm (*Phœnix*

* I have used these spines instead of dissecting needles, when working with the microscope, and find them more serviceable than any manufactured instruments.

dactylifera), there are some which blister the mouth if eaten. The fruit of *Arenga saccharifera* produces severe inflammation, and was, as Dr. Lindley tells us, "employed as the basis of the 'infernal water' which the Moluccans used, in their wars, to pour over their enemies." ("Vegetable Kingdom.")

Having pointed out some of the points in which palms differ from each other, you will naturally ask, "What are their characteristic resemblances? and how are we to know that they are indeed all palms?" In this, that they always produce great numbers of minute flowers (usually the male and female organs in separate flowers, or even on different trees), borne upon a repeatedly branched scaly stem, and the whole inflorescence covered and protected in its young state by a large sheath called a spathe. The flowers are generally so extremely numerous that they almost defy computation; for instance, a single spathe of the date palm, so common in Egypt and the East, often contains more than 10,000 individual flowers.

We generally look upon palms as exclusively the denizens of the tropics, and, as a general rule, this idea is correct, but it is a rule which has many exceptions. The date palm (*Phœnix dactylifera*) is cultivated on the northern shores of the Mediterranean, but does not attain the perfection it does in more southern regions. But *Chamærops humilis*, a dwarf kind of fan palm, grows commonly in the marshy parts of Italy and Spain, its native habitat. Another species of the same genus (*C. palmetto*) is equally abundant in the swamps near New Orleans. China possesses two or three kinds, which will succeed out of doors in the warmer parts of England. New Zealand has one palm of its own too, *Areca sapida*. But they luxuriate most on the sides of the Amazon, and other hot and moist parts of South America, as well as in the humid climate of the East Indian Islands. These places are the headquarters of the tribe, and here they are found in immense numbers and great variety. One circumstance connected with them is somewhat curious, that is, that they are often so very limited in their geographical range: one species is often found growing on some particular island, and in no other place in the world, and that although the plants with which it is associated are found scattered over thousands of miles. The double cocoa-nut (*Lodoicea Seychellarum*) is an example of this. It is found only upon a group of rocky islets (none of which are more than a few miles across) in the Indian Ocean—the seldom-visited Seychelles. The fruit of this palm is very large, often weighing more than twenty pounds. The early navigators often saw it floating on the sea, or cast ashore upon some far-away beach, but never saw it hanging from the tree; they consequently supposed it grew beneath the waves, and gave it the name of Coco-do-mar. In those days everything rare or curious was endowed with great medicinal properties, and it is therefore by no means extraordinary to find that these wonderful fruits were supposed to furnish antidotes for nearly "all the ills that flesh is heir to," and that they sold for almost fabulous prices.

Looking round us in this great hot-house, we find that the plants have been selected so as to show the typical forms of most of the genera of palms, but not exclusively of this family, though they occupy the first place, and, as we are not speaking of tropical plants generally, we will pass the others over. We can only spare space to mention a few of the most remarkable of them: the toddy palm (*Caryota urens*), with its curious jagged and torn leaves, which needs only to be tapped in order to supply the "toddy," of which East Indian travellers speak; one of the cocoa-nut family (*Cocos plumosa*) is now in flower, and is the first which has bloomed in Europe; *Seaforthia elegans*, the Australian cabbage palm, also producing its gracefully drooping, rosy spikes of flowers at the base of the leaves; *Phytelephas macrocarpa*, whose seeds furnish the celebrated vegetable ivory; *Sabal umbraculifera*, the great fan palm, bearing hundreds of its small, black, ripe fruit; several species of the date palm; *Martinezia caryotæfolia*, whose stem is completely covered with formidable spines; *Arenga saccharifera*, the East Indian sago palm, whose leaves are at least thirty feet long; a whole group of the American *Chamædoreas*, the flower-spikes of some being a brilliant scarlet; and of the canes (*Calamus*) from the Eastern hemisphere. But I should only weary the reader by giving a dry list like this, and to speak of the uses and appearance of these glorious trees would occupy too much space at present; should it prove interesting, I may return to the subject at some future time.

Kew Gardens. C. W. Crocker.

RESEARCHES AMONG GARDEN PEBBLES

No one would be surprised to hear that rarities had been received from the banks of the Amoor. A naturalist going out to follow the course of that vast river—so much more interesting to us now than heretofore, in consequence of our expected intercourse with Japan and the neighbouring regions—might reasonably expect to see a great deal that he had never seen before, much of which he had never heard, and something that no one else had ever seen. He would probably meet with animal forms, of various kinds, new to zoology, and plants of which no botanist had ever peered into the flower to count the stamens and pistils.

"Every tributary of the Amoor," we are told, "swarms with fish." With what fishes? As a river on the southern coast of Asia furnishes a fish which delights in wriggling itself up the bank—high, if from the dew on the herbage not altogether dry—to slide along and forage in the country, the strange reverse of those Cantonese who forsake the land to dwell always on the water; and the adjoining sea supplies another—*Toxotes jaculator*, the archer (if it had been named in these days we should have called it, more appropriately, the rifleman), who gets his living by literally shooting the flies as they sit on the rocks over his head, squirting his glistening missile, a drop of his native element, upon his victim, with almost unerring aim, at a distance of three or four feet; there is no saying, although we may utterly abjure "natural selection," what Nature, in the old-fashioned way, may have done for the scaly curiosities of that "dragon river," as it is called by the Celestials. Who knows what dragons it may contain? Then "the mouth of it," we read—and it is a wide one—"is concealed by the vast number of aquatic plants" which it produces. What giant frog-bit, or water-soldier, or fringed buckbean, or water-lily, or other monster cousin of some favourite among our natives, may not be spreading his grand leaves, or opening his glorious blossoms there, to be seen, as yet, by no one but some broad-visaged, fox-eyed Tartar, who had rather, ten thousand times over, gather a handful of black beans, than gaze upon a new flower, though it were as magnificent as that of the *Victoria regia* itself.

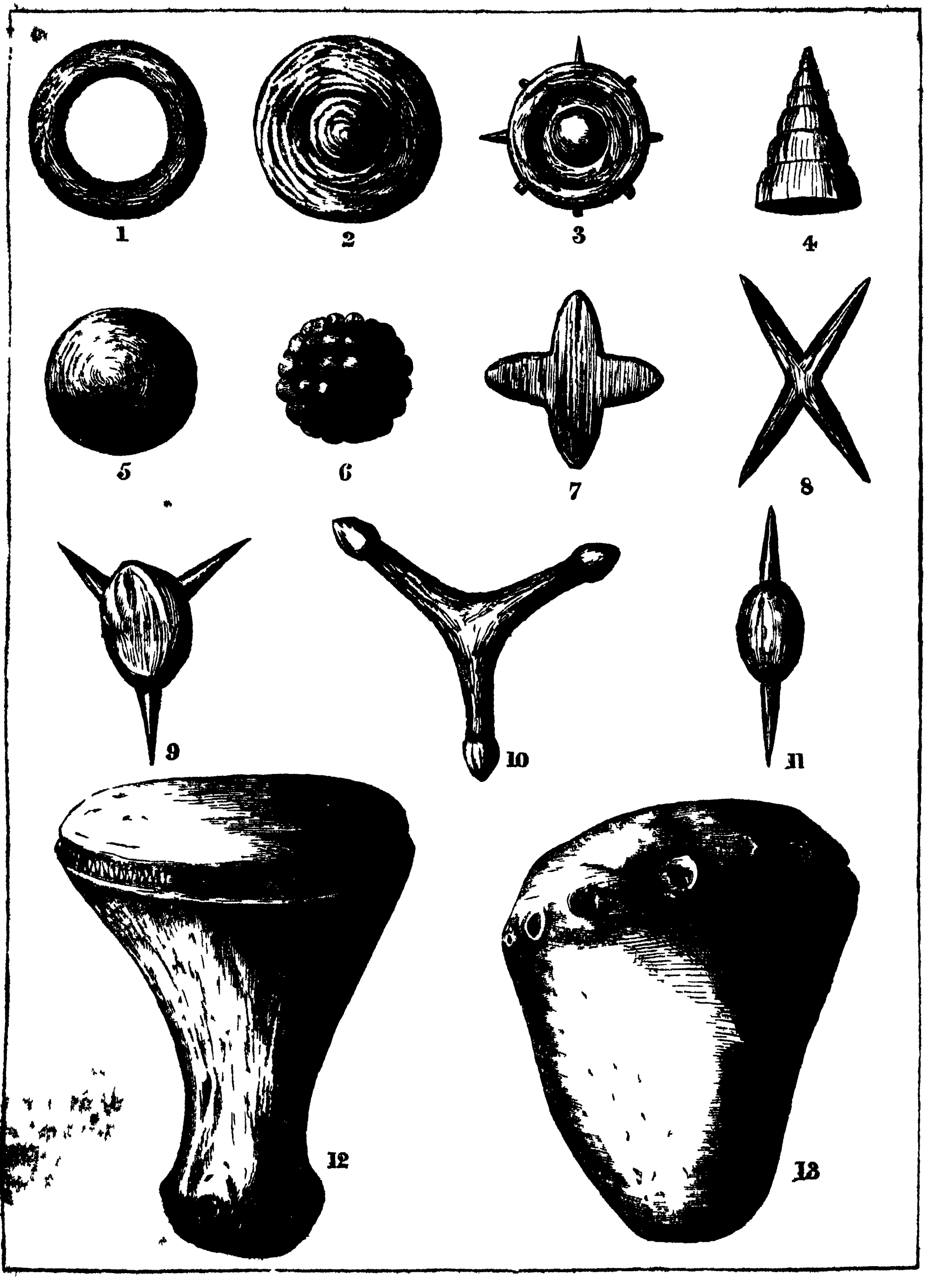
Well, sooth to say, we do feel a little envious of those who are to make the civilized world acquainted with the wonders, or any part of them, which those far distant regions of the Orient will assuredly supply. But this is an achievement for our betters; it is not our fate to explore the banks of that, or any other distant stream—we shall never wander far from home, that is pretty certain. But what then? Is it equally certain that we shall never find anything new or curious at home?

Have you, for your part, ever tried to do so, gentle reader? Have you thoroughly examined all the nooks and crannies, all the shallows and depths, all the surface and substrata of the domain, be it small or great, which you happen to call your own? Are you accurately acquainted with the contents of your own garden?

Perhaps you begin to think of what you found there when you poked in it as a child. You recollect the beautiful irridescence of some decaying fragment of ancient green glass which charmed your eye. And well it might; for you may safely lay your account at never finding any gem of equal beauty, go where you will. Or you call to mind the relics of quaint tobacco-pipes, with very small bowls, and very thick, straight stems—importations from Holland before the craft flourished in these parts—which you used to collect as bolts for your crossbow, to let fly at, but seldom to hit. the still-speckled robins, or other tame youngsters that were innocent enough to sit and watch the murderous attempts you were making upon their persons, not suspecting that you could wish to hurt them; or perhaps you have some reminiscence—you almost wish you had not—of having picked up a coin, thin in substance, irregular in outline, and green in colour, which some knowing playfellow or other, a collector, bought of you for a peg-top, and carried off, to be treasured up, as you now feel inclined to fancy, among the early Henries and Edwards in the shallow, velvet-lined drawers, the *adyta penetralia* of his cabinet. It may be a consolation to you to hear that it is a thousand to one, and much more, that it was only a shop-token, of no value whatever. Still, if we are to judge at all of the worth of things by the pleasure we feel in possessing ourselves of them, it is not to be doubted that these archæological acquisitions of our juvenile experiences were not to be utterly despised.

We imagine that we can hear you thinking audibly that these are very trifling objects, and new to no one, and that you expected to be introduced to something of more importance. Wait a moment—look at the figures in the annexed cut, they represent none of these common things, and we assure you the originals turned up in an old Essex garden.

After the abundant rains of the last few months—rains much desired by those who had watched the effect of the three preceding dry winters on the state of the springs—there was sure to be plenty of well-washed pebbles lying on the surface of any pebbly ground which had been turned over in the antumn, and there was a good crop of such stones inviting inspection, in our own kitchen-garden, so we took a turn to look at them. Perhaps you think it a strange thing that any one should dream of giving heed to such rubbish. Have you never seen the industrious collectors of pebbles, male and female, or heard the click of their hammers, as they bent over the shingle at the watering-places on our south coast? They find something interesting to them there, no doubt. Ah, but those are seaside pebbles, you say. Has it never occurred to you, or to them, that you and they have the very same kind of stones in your gardens and gravel-walks at home? and that the chief difference between the two sources of supply is, that those on the shore have been made fit for the fingers and practicable for examination by the thorough ablutions they have undergone at each returning tide? Many of them have been recently ground by the action of the waves, perhaps, and so show the colours and other secrets of their interior better than the faded or rusty stones of the surface inland; but otherwise they are in the main identical, and one may find as many objects for study or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for the collection in every thousand of them in the one place as in the other.

However, on a fine bright day in the early part of this present month of April, we spent half an hour in looking over the domestic shingle-bed before mentioned, and not altogether without success; several fossils of one kind or another were picked up. Among the rest was a broken flint, about the size, and not unlike the shape, of the half of a small Windsor pear. The general arrangement of the gray marks of the inside—although there was nothing very definite to be seen—was enough to convince a practised eye that it was a fossil sponge; and, as it lay in the hand, it received a slight tap with the hammer. It broke; and there fell out, of a small hermetically-sealed cavity within it, a white powder. There was not more of it than a very moderate consumer of rappee would mete out to one of his nostrils—a small pinch at the most; but it was white as the driven snow, fell heavily on the glove, and lay there unmoved by the spring breeze, which was stirring at the time, though not ungently. It was evident from this fact that it was not an impalpable dust; the grains were of some size, and might be fossils. They were conveyed forthwith into the study, dropped into a test-tube of clear water, wherein they sank straight to the bottom, leaving scarcely a cloud in the liquid through which they passed. It was plain to see as they descended that they were not coarse shapeless lumps, which would have been an ill omen; they looked round and much of a size, and we had good hopes of seeing something. But there was little notion of seeing anything new. So many sponges of the chalk flints had been already examined, that nothing was thought of but the opportunity of finding a better specimen than had been heretofore secured of some organism quite familiar to us.

The lens was soon turned upon these, however, and a glance was sufficient to show that we had been lucky that morning. There lay, brilliant from their exceeding whiteness, in striking contrast with the dark slate slab on which they had been deposited, a host of sponge spicules of perhaps eleven different forms, five of which (Figs. 1, 2, 3, 10, and 11) were absolutely new to us, and three others (Figs. 4, 6, and 9) so unlike in appearance to those of which they may perchance be the representatives as not to be at once recognized. The "Micrographic Dictionary" was taken down; but, although it exhausts the Roman and borrows a portion of the Greek alphabet to find letters of reference enough for the many curious figures it displays, there was only one to be seen like any of them. Mantell's "Medals of Creation" was examined with as little success. Upon considering the spicules represented in "Geology in the Garden," three of them only seemed near akin to three of those before us (Figs. 4, 6, and 9).

But let us examine them. Fig. 1 proclaims its own name. It is a simple ring; the annular spicule, then. 2 is like a solid round-edged wheel, with a slightly raised nave; rotate. 3 is a very curious spicule. It has the appearance of a ring or hoop, with a membrane stretched tightly over it, in the centre of which is a slight elevation, while from the outer margin of the whole, at exactly equal distances, protrude eight spines; clypeate, octoradiate, might suitably characterize it. 4 is sugar-loaf shaped, and encircled from base to summit with rings; conoid, annulate, would convey an idea of its form. 5 is the ever-prevalent globular spicule. 6 is also spherical, ornamented with round protuberances; globular, mammillated, therefore. 7 and 8—roughly figured, as one by Dr. Mantell, apparently—are cruciform. 9 is possibly a variety of the ordinary triradiate spicule. It is obscurely heart-shaped, with three horns, two at the broader and one at the narrower end; cordate, cornute, might be admissible, if it should require a name.

10 is triradiate; but, unlike the one which is so familiar to us, which has three needle-like points, each of its three arms ends in a roundish knob; it may be described, therefore, as triradiate, with capitate rays. 11 is egg-shaped, with a slender shaft passing through it in the direction of its longer axis; ovate, verruculate, perhaps.

In all probability five of the above at least, perhaps eight, have neither been figured nor described before; and if so, a stone, which has been knocked about with the spade and turned over with the hoe or rake, once or twice a-year for centuries, it may be, proves to be a casket—an agate casket we might call it, without much exaggeration—in which has been locked up unknown curiosities (who shall say how ancient?), which in every quality—fineness of material, delicacy of form, accuracy of finish—would defy all the guilds of fairyland to produce their like. And so much for home researches.

Marvellous is the variety of design exhibited in these tiny bones of sponges; for bones, according to the office they fulfil in the animal economy, they may fitly be called. The living jelly, which is the creature's flesh, is rendered firm by the intermixture and interlacing of these calcareous or siliceous rings, and pins, and caltrops, and hooks, and crutches, which are so arranged, we may be sure, as to give mutual support to one another. Humble as they are among natural objects, then, they bear clear testimony to the wisdom which the Creator has been pleased to manifest in his works; for what cunning of the skilled artificer would suffice to mould such atoms of the proper shape, and dispose them in the positions required, for the purpose they are to answer? The measuring and adjusting of these microscopic balls and rings, and placing them in dependence one upon the other, required the same hand that framed the huge orbs of heaven, and launched them into space to gyrate for their appointed time round the vast circles which they describe. Well worthy of contemplation are these minute objects, then, even in this high point of view.

But they may prove to be of use to science also, perhaps, by helping us to distinguish one species of sponge from another; or they may serve to determine the question of the nature of the ventriculite.

One kind of branching sponge, when enveloped in flint, has a considerable likeness to the root of the ventriculite, and may be easily mistaken for it, if it so happens that it exhibits no marks of structure at the smaller end. The specimen represented in our cut (Fig. 13) may be a sponge, or the root of a ventriculite. The ventriculite—fossil mushroom—most commonly occurring in the flint gravel has properly, when full grown, the form of Fig. 12. The holes round the bottom mark the places where the roots passed into the soft chalk, perhaps. But as they now appear in the flint, they are not to be readily distinguished from perforations of the same character left by the ends of the branches of some kinds of sponge. And as neither the mushroom-like form, nor the indented margin, exhibited in Fig. 12, has place in the very young ventriculite, there is some danger that those who have not the opportunity of comparing a considerable number of specimens may confound the two fossils.

The question is, Does the root part of the ventriculite afford any spicula which properly belong to it? Mr. Toulmin Smith says, No; for the ventriculite is a polypidom—the framework of a vast assemblage of minute polypes. Others reply, It may have spicules; for there is nothing actually known which forbids the belief that these fossils are the remains of a highly organized kind of sponge. Certain it is that upon breaking the flints which contain the roots of ventriculites, many spicules are often found placed exactly where they might be looked for were these fossils the remains of sponges. HENRY ELEY.

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THE STRUCTURE AND MOVEMENTS OF COMETS.

"The blazing star,
Threatening the world with famine, plague, and war;
To princes, death; to kingdoms, many curses;
To all estates, inevitable losses;
To herdsmen, rot; to ploughmen, hapless seasons;
To sailors, storms; to cities, civil treasons."

APPEARING suddenly in the nocturnal sky, and often dragging after them tails of immense size and brilliancy, comets were well calculated, in the earlier ages of the world, to attract the attention of all, and still more to excite the fear of many. It is the almost unanimous testimony of history, during a period of upwards of 2000 years, that comets were always considered to be peculiarly "ominous of the wrath of heaven, and as harbingers of wars and famines, of the dethronement of monarchs, and the dissolution of empires;" and, indeed, those times have not long since passed away. However little attention might have been paid by the ancients to the more ordinary phenomena of Nature, yet certain it is that comets and total eclipses of the sun were not easily forgotten or lightly passed over. Hence the aspect of remarkable comets that have appeared at various times have been handed down to us, often with circumstantial minuteness.

A comet usually consists of three parts, developed somewhat in the following manner:—A faint luminous speck is discovered by the aid of a good telescope (Fig. 1); the size increases gradually, and after some little time a *nucleus* appears, that is, a part which is more condensed in its light than the rest (Fig. 2), sometimes circular, sometimes oval, sometimes even radiated like a star. Both the size and brilliancy of the object still progressively increase, the *coma*, or cloud-like mass around the nucleus, becomes less regular, and a tail begins to form, becoming fainter as it recedes from the body of the comet. This tail increases in length so as sometimes to spread across a large portion of the heavens; sometimes there are more tails than one, and frequently the tail seems broken off, or much narrower in parts. The comet approaches the sun in an undulating curvilinear path, which is frequently almost a straight line. It generally crosses that part of the heavens in which the sun is placed, so near the latter body as to be lost in its rays; but it emerges again on the other side, frequently with increased brilliancy and length of tail. The phenomena of disappearance are then, in the reverse order, the same as those of its appearance.

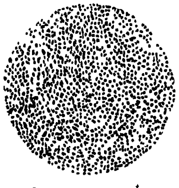

FIG. 1.—Telescopic Comet, without a nucleus.

FIG. 2.—Telescopic Comet, with a nucleus.

In magnitude and brightness comets exhibit great diversity; some are so bright as to be visible in the daytime; others, and indeed the majority, are quite invisible, except with powerful optical assistance. Such are usually called telescopic comets. The appearance of the same comet at different periods of its return is so varying, that we can never identify a given comet with any other by any mere physical peculiarity of size or shape, until its elements have been calculated and compared. It is now known that "the same comet may, at successive returns to our system, sometimes appear tailed, and sometimes without a tail, according to its position with respect to the earth and the sun, and there is reason to believe that comets in general, from some unknown cause, decrease in splendour in each successive revolution." (Smythe, "Cycle," vol. i. p. 235.)

The periods of comets in their revolution vary greatly, as also do the distances to which they recede from the sun. Whilst the orbit of Encke's comet is contained within that of Jupiter, the orbit of Halley's extends beyond Neptune. Some comets, indeed, proceed to a far greater distance than this, whilst others are supposed to pass into curves, which do not, like the ellipse, return into themselves. In this case they never come back to the sun. Such orbits are either *parabolic* or *hyperbolic*. The density or mass of comets is exceedingly small, and their tails consist of matter of such extreme tenuity, that the smallest stars are seen through them—a fact first recorded by Seneca. That the matter of comets is exceedingly small is abundantly proved by the fact, that they have, at times, passed very near to some of the planets without disturbing their motions in any appreciable degree. Thus, the comet of 1770 (Lexell's), in its advance to the sun, got entangled among the satellites of Jupiter, and remained near them four months, without in the least affecting them, as far as we know. It can, therefore, be shown that this comet's mass could not have been so much as 1-5000th that of the earth. The same comet, also, came very near the earth on July 1, its distance at 5h. that evening being about 1,400,000 miles; so that, had its quantity of matter been equal to that of the earth, it would, by its attraction, have caused our globe to revolve in an orbit so much larger than at present, as to have increased the length of the year 2h. 47m., yet no sensible alteration took place. The comet of 837 remained for a period of four days within 3,700,000 miles with a similar result. A very little argument, therefore, suffices to show the futility of the idea of any danger happening to our planet from the advent of any of these wandering strangers. Indeed, instead of comets exercising any influence on the motions of planets, there is the most conclusive evidence that the contrary influence prevails, of planets on comets. This fact is strikingly exemplified in the history of the comet of 1770, just referred to. At its appearance in that year, this body was found to have an elliptical orbit, requiring for a complete revolution only 5½ years; yet this comet, although a large and bright one, had never been observed before, and has, moreover, never been seen since; the reason being that the influence of the planet Jupiter, in a short period, completely changed the character of its course round the sun.

A comet may move either in an elliptic, parabolic, or hyperbolic orbit; but, for reasons with which our mathematical readers are acquainted, no comet can be periodical which does not follow an elliptic path. In consequence, however, of the comparative facility with which the parabola can be calculated, astronomers are in the habit of applying that curve to represent the orbit of any newly-discovered body. Parabolic *elements* having been obtained, a search is then made through a catalogue of comets, to see whether the new elements bear any resemblance to those of any object that has previously been observed; if so, an elliptic orbit is calculated, and a period deduced. The elements of a parabolic orbit are five in number:—

1. The *time of perihelion passage*, or the moment when the comet arrives at its least distance from the sun.*

2. The *longitude of the perihelion*, or the longitude of the comet at the time it reaches this point.

3. The *perihelion distance*, or the distance of the comet from the sun, expressed in radii of the earth's orbit, taken as unity.

* In an elliptic orbit, the corresponding extreme distance from the sun is called the *aphelion*.

4. The *longitude of the ascending node* of the comet's orbit, as seen from the sun.

5. The *inclination of the orbit*, or the angle between the plane of the orbit and the ecliptic.

It is also necessary to know whether the comet moves in the order of the signs, or in the contrary direction: in the former case its movement is said to be *direct;* in the latter, *retrograde*. In an elliptic orbit we require to know the *eccentricity;* from which, with the perihelion distance, we can ascertain the length of the major axis, and consequently the comet's periodic time. We should remark that the eccentricity is not the linear distance of the centre of the ellipse from the focus, but the ratio of that quantity to the comet's mean distance. Up to the present time the orbits of about 270 comets have been calculated.

To the early astronomers the motions of comets gave rise to great embarrassment. Tycho Brahe, the celebrated Dane, thought that they moved in circular orbits; Kepler, on the other hand, suggested a straight line. Hevelius seems to have first remarked that cometary orbits were much curved near the perihelion, the concavity being towards the sun. He also threw out an idea relative to the parabola, as being the form of a comet's path, though it does not seem to have occurred to him that the sun was likely to be the focus ("Cometographia," fol., Gedani, 1668). Borelli suggested an ellipse or a parabola. Sir William Lower was probably the first to hint that comets sometimes moved in very eccentric ellipses; this he did in his letter to his "especiall goode friend Mr. Thomas Harryot," dated February 6, 1610. Dirfel, a native of Upper Saxony, however, was the first to prove anything; which he did in 1681, by showing that the celebrated comet of the preceding year moved in a parabolic orbit.

History informs us that some comets have shone with such splendour as to have been distinctly seen in the daytime. The comets of 45, 575 A.D., 1106, 1402, 1532, 1577, 1618, 1744, 1843 (i.), 1847 (i.), 1853 (iii.), are the principal ones which have thus been observed. There are several well-established instances of the separation of a comet into two or more portions. Seneca mentions an instance ("Quest. Nat.," vii. 16). Such was the case with Biela's comet in 1845. When first detected, on November 28, it presented the appearance of a faint nebulosity, almost circular and with a slight condensation towards the centre; on December 19, it appeared somewhat elongated, and by the end of the month the comet had actually separated into two distinct nebulosities (Fig. 3), which travelled together for more than three months; the maximum distance (157,240 miles) was attained

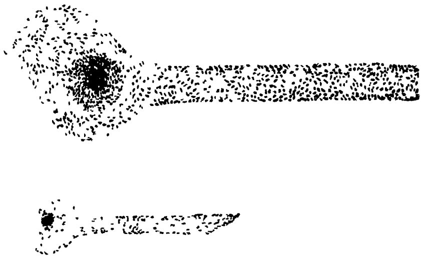

FIG. 3.—Biela's Comet, 1846. (Telescopic view.)

on March 3, 1846, after which it began gradually to diminish until the comet was lost sight of in the middle of April. At its return in 1852, the separation was still maintained, but the distance had increased to 1,250,000 miles. At its return in 1859, the comet does not appear to have been detected, owing to its unfavourable position.*

The question whether or not comets are self-luminous, has never been satisfactorily settled. The high magnifying power that may sometimes be brought to bear on them tends to show that they shine by their own light. Herschel was of this opinion from his observations of the comets of 1807 and 1811 (i.).

* Comet i. of 1860, discovered in Brazil by Liais, had a double nebulosity, resembling, it would seem, that of Biela's comet.

It is manifest, however, that if the existence of phases could be certainly known, this would furnish an irrefragable proof that comets shine by reflected light. It has been asserted, from time to time, that such phases have been seen, but the statements made are unsupported. Delambre mentions that the registers of the Royal Observatory at Paris exhibit undoubted evidence of the existence of phases in the comet of 1682. Neither Halley nor any other astronomer who observed this comet have given the slightest intimation of their having seen phases. James Cassini mentions the existence of phases in the comet of 1744 ("Mém. Acad. Sciences," 1744, p. 303); on the other hand, Heinsius and Chésaux, who paid particular attention to this comet, positively deny having seen anything of the kind. More recently, Cacciatore, the celebrated Italian, expressed a positive conviction that he had seen a crescent in the comet of 1819. "It was found, however, that the position he assigned to the line forming the horns of the crescents, was incompatible with the supposition that the comet shone by the light of the sun."

Arago sums up by saying that the observations of M. Cacciatore prove only that the nuclei of comets are sometimes very irregular ("Pop. Ast.," vol. i. p. 627, Eng. ed.). Herschel states that he could see no signs of any phases in the comet of 1807, although he fully ascertained that a portion of its disc was not illuminated by the sun at the time of observation ("Phil. Trans.," 1808, p. 156). The general opinion now is against the existence of phases, and thus we must consider that comets shine by their own inherent light.

Some comets have been observed with round and well-defined planetary discs. Seneca relates that one appeared after the death of Demetrius, king of Syria, but little inferior to the sun, being a circle of red fire, sparkling with such a light as to surmount the obscurity of night. The comet of 1652, seen by Hevelius, was nearly as large as the moon, and well defined, though not nearly so bright.

There are several curious phenomena connected with the tails of comets which require notice. It was observed by Pierre Apian that the trains of five comets, seen by him between the years 1531 and 1539, were turned *from the sun*, forming an imaginary prolongation of the radius vector, or the line joining the sun and comet; as a general rule this has been found to be the case,* although exceptions do occur. Thus, the tail of the comet of 1577 deviated 21° from the line of the radius vector. In some few instances, when a comet had more than one tail, the second extended more or less *towards* the sun, as was the case with the comets of 1823 and 1851 (iv.). Although comets usually have but one tail, yet two is by no means an uncommon number (Fig. 4), and indeed the great comet of 1825 had five tails, and that of 1744 as many as six, according to Chésaux. The tails of many comets are curved so as frequently to resemble in appearance a sabre; such was the case with the comets 1843, 1844 (iii.), and 1858 (v.) amongst others. The comet of 1769 had a double curved tail, thus ∽.

FIG. 4.—Comet i. 1847, on March 30, with a bifid tail. (Telescopic view.)

The trains of some great comets have been seen to vibrate in a manner somewhat similar to the Aurora borealis. These vibrations commence at the head, and appear to traverse the whole length of the tail in a few seconds. It was long supposed that the cause was connected with the nature of the comet itself, but Olbers has pointed out that such appearances could only be fairly attributed to the effects of our own atmosphere, for this rea-

* The researches of M. Edward Biot show that this fact was known to the Chinese long before the time of Apian ("Comp. Rend." xvi., p. 751).

son:—"The various portions of the tail of a large comet must often be situated at widely different distances from the earth, so that it will frequently happen that light would require several minutes longer to reach us from the extremity of the tail than from the end near the nucleus. Hence, if the corruscations were caused by some electrical emanation from the head of the comet, even if it occupied but one second in passing over the whole surface, several minutes must necessarily elapse before *we* could see it reach the tail. This is contrary to observation, the pulsations being almost instantaneous."

Comets have been seen to pass over the sun's disc. One of the most remarkable instances occurred on the morning of November 18, 1826. The phenomenon was anticipated by Gambart, and said to have been witnessed by him and Flaugergues. There is some doubt on this point.

The following is an excellent instance of the ever-changing appearance of comets; it relates to the one of 1769:—On August 8, Messier, whilst exploring with his two-foot telescope, perceived a round nebulous body which turned out to be a comet. On the 15th the tail became visible to the naked eye, and appeared to be about 6° in length; on the 28th, it measured 15°; on September 2, 36°; on the 6th, 49°; on the 10th, 60°. The comet having now plunged into the sun's rays, ceased to be visible. On October 8, the perihelion passage took place; on the 24th of the same month it reappeared, but with a tail of only 2°; on November 1 it measured 6°; on the 8th it was only $2\frac{1}{2}$°; on the 30th it was $1\frac{1}{2}$°. The comet then disappeared" ("Mém. Acad. Sciences," 1775, p. 392).

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A LESSON IN PHYSIOLOGY.

"I HAVE often entertained the idea of studying physiology, and should very much like to commence; but it is too formidable an undertaking. The very terms employed are of themselves sufficient to prevent a non-scientific man from following such a pursuit. Besides, to do so effectively, one ought to observe the operations of a dissecting-room, and these I have neither the taste nor the opportunity to witness."

These were the remarks by which we were met, as we one day advised our friend W——, who was in a somewhat depressed state of mind in consequence of a sudden bereavement, to apply himself to the study of zoological or physiological science, as a means of diverting his thoughts, to some extent, from the subject that caused him so much grief and preyed so seriously upon his mind.

"If you commenced your studies by attempting at once to investigate and comprehend the intimate parts of the human anatomy, no doubt you would find your task somewhat perplexing; but come and visit me this evening, and we will see whether there is no easy ascent to the ground that you desire to attain. I will endeavour to put you in the right track, and you may then use your discretion as to whether or not you will prosecute your journey."

"Agreed," said our friend; and it was arranged that on the following evening we should be prepared with a suitable object, from which our first lesson might be derived.

The next morning being remarkably fine, we took the opportunity of making an excursion to a neighbouring pond, for the purpose of seeking the desired specimen for our friend,* who, punctual to his appointment, made his appearance in the evening.

"What on earth have you got there?" he exclaimed, as, entering our parlour, he found us busily employed in adjusting our microscope, to examine one of the results of our morning's search.

"A hungry creature, to which I have just given a meal, in order that it may the better serve to illustrate the process of digestion."

Our friend approached with rather an inquisitive look, but when we placed in his hand the glass slide, upon which we told him there lay the object to be examined, he uttered an exclamation (which you, reader, are quite at liberty to imagine), indicating his conviction that we had invited him for the express purpose of amusing ourselves at his expense. And, in fact, our friend's remark was quite anticipated by us; for, to the ordinary observer, there was nothing visible upon the slide, excepting a small square piece of thin glass, apparently possessing a bluish tinge. Laying the slide upon the stage of the microscope, however, and adjusting the focus, we quietly drew our friend back to the table (for he had turned sullenly away from us, and was seeking the nearest easy chair), and requested that he would examine the slide through the instrument. Just imagine his amazement, when, on looking through the tube, he saw the creature here represented (Fig. 1) swim slowly across the illuminated field!

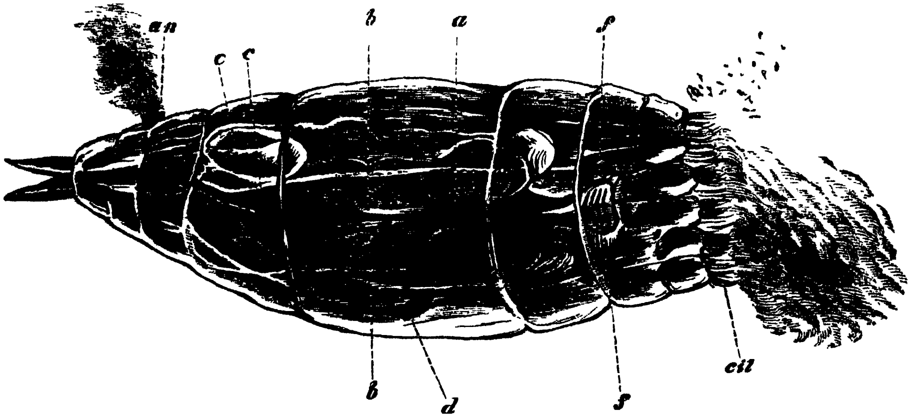


FIG. 1.—Hydatina senta, as it appears when fed with indigo. *a*, stomach; *b*, rudimentary liver; *c*, cloaca, or distended termination of the alimentary canal; *an*, anus, excretory aperture; *d*, young in process of development; *e*, contractile vessel, rudimentary heart; *f*, jaws. The cilia (*cil*) are seen to attract numerous currents of indigo, and repel unsuitable substances in the opposite direction.

"Well," said he, after his surprise had to some extent abated, "I owe you an apology; but I really thought you were trifling with me. What is this creature? Was it really upon that slide?" (and he looked doubtingly at the last named). "And how many times is it magnified? and where did you get it?"

We removed the slide once more, and pointed out to him a diminutive, white, mov-

* A very simple and effective method of procuring the aquatic inhabitants of pools, is by dragging a ring net, made of calico, and screwed to the end of an ordinary walking-stick, through the vegetation growing in or upon the surface of the water; and then, having allowed the water to drain off, pouring the sediment that remains in the net into a wide-necked pomatum-bottle, which has been previously filled one-half or two-thirds full of clear water from the same ... A little p- .ctice will soon enable the student ...guish the larger forms of animalculæ, and ... them by means of a glass "dipping-tube," to ... of the microscope.

ing speck, beneath the covering glass, which protected the drop of water upon the slide, and which contained, along with the animalcule, a little indigo in solution, that was to serve it as a supply of food.

The animalcule is called *Hydatina senta,* a name given to it, I believe, by a Prussian microscopist, called Ehrenberg,* who has devoted his whole life to the investigation of these minute forms of animal existence, and I have selected it in consequence of its transparency, the simplicity of its internal structure, and the facility with which it may be obtained from almost any pool or running stream.

It belongs to a group of animals of the worm tribe, called *Rotatoria,* from a peculiar apparatus they possess, and which will be described hereafter. An examination of its external form will show you that the body is divided into rings or sections, and at the posterior termination you will notice a kind of forked tail or "pedicle," which serves as a member of locomotion, the creature employing it to grasp objects as it proceeds, and by this means to pull or push itself onwards.† At the anterior part of the body, and almost continuous with it, is the head, and quite in front you will find the "rotatorial" apparatus, which serves as an organ of locomotion and nutrition (Fig. 1).

This remarkable appliance consists of a vast number of minute hair-like fibres, prolongations of the delicate external investiture of the animal, termed *cilia,* which are kept in a state of constant vibration, causing a current of water to flow continuously in the direction of the mouth, and to bring with it the food upon which the animalcule subsists; in this case, as you see, particles of indigo.

* Ehrenberg discovered an almost incredible number of microscopical organisms, but his account of the natural history and anatomy of these creatures is by no means correct.

† The pedicle of *Hydatina,* and other rotatorial worms, corresponds with the same organ in the *Natantia,* or larger swimming worms.

"What!" exclaimed our friend, "do you mean to say that those little flakes are the indigo that you have dissolved in the water?"

Most assuredly; for although to the naked eye the water drop seems to be merely tinged with blue, yet when you examine it microscopically, you can thus detect the particles held in solution. But to resume.

In another species of the group (*Rotifer*) this ciliary apparatus so closely resembles a pair of revolving wheels, that it was long believed to be such, and the creature was commonly known as the "wheel-animalcule."

The food, then, being conveyed to the mouth through the agency of these cilia, enters the gullet, or, as it is scientifically called, the "œsophagus;" and is there subjected to a masticating process, by means of a pair of jaws, which you will perceive working incessantly to and fro, but at some little distance from the ciliary apparatus.*

These jaws, which are shown considerably magnified in Fig. 2, *f,* may be said to foreshadow the masticating organs of the higher races of animals, more especially those of the insect tribes.

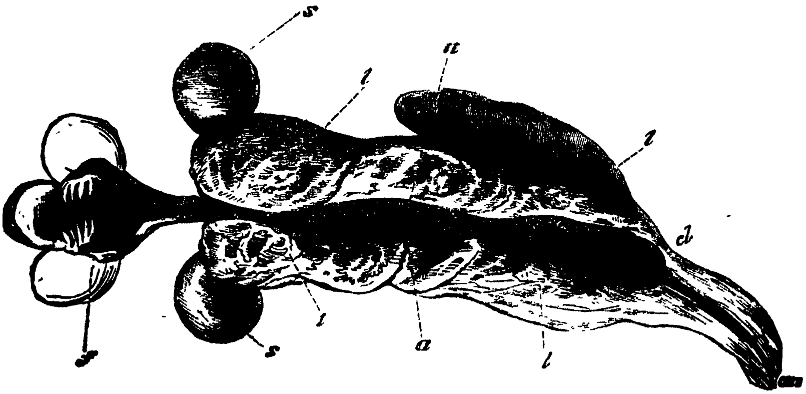
Having gone through this ordeal, the food then passes rapidly into the simple stomach (Figs. 1, *a,* and 2), where you may see the blue substance accumulated in considerable quantities, and there it is duly digested.

In *our* case you are aware that this function takes place through the solution of the food in the stomach by the gastric juice, which converts it into a kind of creamy com-

* If the reader should not have a living specimen for observation, he may easily comprehend the character of the movement performed by the jaws, if he partially closes his fists, and placing the palms and knuckles in juxtaposition, works them against one another by opening and closing the fingers. A similar motion in these jaws enables them to knead the food in its passage.

pound, termed "chyme." This chyme passes on into the alimentary canal or intestine, at the commencement of which it is mixed with the fluid secreted by the liver, well known to you as the "bile," and the nutritive portion of the chyme, 'the "chyle," as it is called, is absorbed in a liquid form, by a special system of vessels, and conveyed by the "lacteals," or chyle-ducts into the blood. In the latter form it is circulated through the system, and aids in the formation of the various tissues of which the body is composed.

having previously yielded up its nutrient materials to the circulating system, it is ejected at the anal orifice (Figs. 1 and 2, *an*). So much for the digestive apparatus of *Hydatina*. This portion of its anatomy is simple enough—is it not?—and nothing can more clearly foreshadow the complicated organs that perform the same function in the higher animals. When you come to examine these, you will find that the higher you rise in the series, the more perfectly do the liver and one or two other organs, which are here obscure, become specialized, each having a



2.—Digestive Apparatus of Hydatina. *j*, jaws; *s*, supposed salivary glands; *l*, rudimentary liver; *a*, alimentary canal; *an*, anal orifice; *cl*, cloaca.

Now, if you examine the stomach and remaining portion of the alimentary passage of *Hydatina* (the whole of which is easily distinguishable through its dark blue contents), you will perceive it to be imbedded in what might be mistaken for green fat (Fig. 1, *b*, and Fig. 2, *l*); this is supposed to be a rudimentary form of the liver, coloured by the bile, which is poured into the stomach (or absorbed through its walls), and there mixes with the food as it progresses. The last-named accumulates in considerable quantities near the posterior extremity of the in- ...e, which is greatly dilated, and forms cloaca (Fig. 1, *c*, and Fig. 2, *cl*); and

distinct place in the body assigned to it, but all communicating with the digestive canal, from which the nutritive fluid is conveyed to the great central organ of circulation—the heart—and constantly propelled by this organ to all parts of the animal frame.

"It is very wonderful," said my friend. "And has this invisible creature a heart and circulating system, as well as a stomach for the digestion of its food?"

Before I answer that inquiry, I must remind you that, as you well know, in order that the blood of the higher animals may be retained in its purity, and enabled, so to speak, to do its duty in the animal fabric, it must be brought from time to time into contact with the atmosphere, to which it gives off the superfluous carbonic acid gas that it has absorbed in its passage through the system, and receive in its place a supply of oxygen. In aquatic animals, the blood derives its oxygen from the air contained in the water, the latter element being admitted into some portion of the body, and brought into communication with the blood-vessels; or, in other cases, the sanguineous fluid is conveyed to some special *external* organ that is always in contact with the water. The interchange of gases takes place between the blood and the atmosphere (or the water in which it is contained) through the membrane of the vessels in which the former circulates.

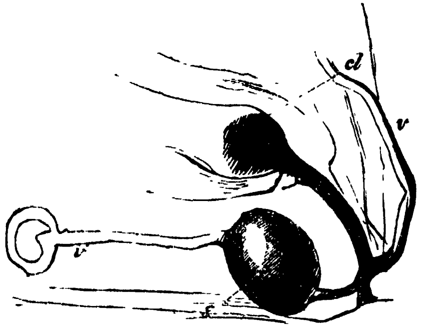


FIG. 3.—Circulating Apparatus *in situ*. *c*. contractile vessel; *cl*, cloaca; *v*, vascular system.

In *Hydatina*, and the other animals of this group, just as the digestive process is extremely simple, so also are those of *circulation* and *respiration*, for the chyle, or nutritive portion of the digested food, finds its way from the alimentary canal into a special system of vessels, where it is, in all probability, mixed with water; and the fluid thus formed is circulated through the body,* in the same manner as the blood of the higher animals.

And now, I am prepared to answer your inquiry, "Whether or not the creature possesses a heart."

If you observe the posterior part of the body carefully, you will perceive a tolerably large transparent vessel, which appears to be oval as you view it, and which suddenly contracts from time to time, and then slowly expands again.

This is the rudimentary "heart," which, when it contracts, forces the "chylaqueous fluid" into the system of vessels connected with it, some of which you may see passing towards the head, on either side of the body; and as it absorbs that fluid (in all probability from the cavity of the body itself), it becomes gradually dilated, and assumes a somewhat globular form.

The little creature is, moreover, furnished with a number of longitudinal and transverse muscles (see Fig. 1), which enable it to contract its whole body to such an extent that it can shrink up into a ball, retracting at the same time its ciliary apparatus and its foot; and this movement, which is frequently repeated, aids considerably in the circulation of the "nutritive fluid."

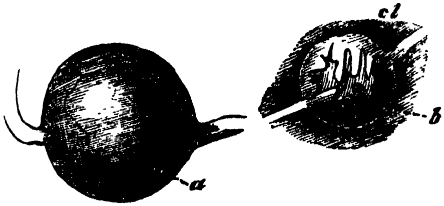


FIG. 4.—Contractile Vessels, with commencement of circulating tubes. *a*, dilated; *b*, contracted

"What is that oval body that I see *above* the digestive organs? it appears more opaque than the other parts, and seems quite immovable."

That is an egg; or, more correctly speaking, an *embryo*, in process of develop-

* This fluid is called "chylaqueous;" and the system of vessels through which it circulates has been denominated the "vascular water system." Another peculiarity of this and other similar forms is, that the whole of the internal portion of the body is, more or less, filled with fluid, which serves as a means of respiration, and perhaps also of nutrition.

ment; for this creature, although so lowly organized, bears its young alive.

But, my friend, I think your first lesson in physiology has been sufficiently protracted. You have seen how a little creature, invisible to the naked eye, may still be formed by the Almighty Hand, perfect in all its internal and external parts; and when I tell you that even a nervous system has been traced within its body, you will perceive that it has its sensations of pleasure and pain, as well as all other animated beings; and I once more recommend you, if you wish to cultivate a nearer acquaintance with Him whose presence may thus be detected even in the invisible world, to pursue the study that we have commenced this evening.

Liverpool. JAMES

PHOSPHORESCENCE.

It is related of Christiana, the daughter of Linnæus, that while walking in her father's garden, in the evening of a hot and brilliant summer's day, now and then watering some favourite plants with her arrosoir, her attention was arrested by flashes of light which were emitted by some flowers of nasturtium. Coleridge, the poet, thus alludes to it:—

> "Tis said, on summer's evening hour,
> Flashes the golden-coloured flower,
> A fair electric flame.'

Strolling at twilight, or in the evening, by the hedge-row, or along the field-path, at this season of the year, especially over the sandy soil of the Surrey hills, you will see little sparkling gems illuminating the banks which divide the fields. Should you be fortunate enough to entrap one of these living jewels, it will be found, on examination by daylight, to have legs and wings, if it be a male, but no wings if it be a female; it is, in fact, an insect which naturalists have named the *Cicindela*, or "Sparkler." You doubtless have heard of it by the familiar name of the glow-worm, more correctly glow-beetle. There is also to be found in the gardens about Twickenham and western parts of Middlesex, a kind of centipede-looking worm, which leaves behind it a trail of phosphoric light, as it takes its moonlight rambles over the gravel walk.

Should you be sailing down the Mersey, or merely crossing that stream in the ferry-boat from Liverpool to Birkenhead, in the autumn time (particularly if the evening be such as to overshadow the harvest moon), you will be delighted and surprised to notice that as the vessel cleaves the water, it will appear to be floating "on the realms of light." A closer examination of the water shows it to be charged with minute infusorial animalcules (*Pyrosoma atlantica*), only to be discovered by a microscope; every one of them, however, glows with light. Down some of the lead mines in Derbyshire, the miners throw out with the ore a pretty greenish-blue crystal stone like bits of the frozen sea. This is called "fluor spar." There is such an abundance of it, that some of the operative chemists sell it at a few pence per pound. If you make this spar warm over a flame, holding it with a piece of wire, and then take it into a dark room, it will shine with a very curious flickering blue light. While in the dark room, be provided with a few lumps of sugar of such ape as you can break between the fingers. Now divide them, and a flash of light will be visible; rub the lumps of sugar together, and there will be more light.

On many of the commons of England, and by the sides of numerous brooks, willow-trees are allowed to grow here and there. One more venerable than the rest has perhaps begun to decay, and you may help yourself to pieces of its trunk without saw or axe. Country boys call it "touchwood," for if a spark fall upon it, it will burn like tinder. When the day has been unusually warm and bright, this touchwood, if taken into a dark place, will shine with a most singular and beautiful phosphoric light.

In that warm region of the earth where Cayenne pepper grows, where the coffee-plant flourishes, and where the sugar-cane is an immense grassy weed, innumerable insects may be seen at sunset skitting and dancing in the air, as we see gnats do during our meadow walk in this country. Every one of these little creatures, called in that country "fire-flies," teems with light, and so brilliant are they that three of them placed under a glass, on a dark night, would give light enough to enable you to read *Recreative Science* or the *Daily News*. The *ignis* or "Will-o'-the-wisp," has afforded the poets and romance-writers many a mythical theme, such as the following by Darwin:—

"On distant swampy heath I see
A Will-o'-the-wisp!—Ah! luckless he
Who to next hamlet bends his way
That glimpse will lead him far astray.

This luminous vapour is often seen during the summer months hovering over marshes, or undrained meadows in the vicinity of stagnant pools; the slightest breath of air causes it to flit and move as if it had life.

Sitting in our garden watching the Queen of Night, the Silver Moon, we see the most glorious example of phosphorescence. Fortunately for me, I live in an age and in a country that allows freedom of opinion and of thought. Unlike Galileo, I shall not be cast out of the pale of society for giving expression to a belief that the light of the moon is not of that nature or quality which the philosophers have hitherto taught. True, I am led to this belief only by analogy; but this mode of reasoning strengthens my idea, because it tells as much against the old reflecting theory as it does in favour of my phosphoric speculation! But this matter cannot be argued here; pass we then on to facts. If sulphate of barytes be calcined in a peculiar manner, it will shine with light after exposure to the sun, even under water. Nitrate of lime melted and kept fused for five to ten minutes, then poured into a hot ladle and allowed to cool gradually, will, when broken up and exposed to the sun's rays, emit a most lovely specimen of artificial moon-light in a dark room.

If we take three parts of well calcined oyster-shells, and one part of powdered fluor spar, thoroughly mixed and strongly heated for an hour, the compound earth will emit a beautiful phosphoric light. The luminous willow-trees, together with Will-o'-the-wisp, have been the foundation of many a ghost-story, as told by some luckless wight, who, after seeing a sweetheart home, has had to return through the meadows to his native hamlet.

Now, all these curious lights may be attributed to one cause, namely, phosphorescence.

The light thus visible differs from the sun's light, and from the light emanating from combustion, in this one particular—that there is no sensible heat with it. Hence, phosphorescence is *pure light*, while ordinary light may be considered to be adulterated with heat, which produces effects independent of the pure principle of phosphorescence.

Hereafter I may record my experiments for producing photographic images from phosphorescent substances. So far we may positively say that phosphoric light bears with it the chemical ray.

SEPTIMUS PIESSE.

A GEOLOGICAL EXCURSION TO THE COTTESWOLD HILLS.

There is one mode of studying geology for which the phrase Recreative Geology is particularly appropriate. We mean practical and personal research in the quarry and on the road-side. It is, indeed, our own opinion that not only is no other method of study so pleasant, but that none other is so successful. The best geologists, both amongst the living and the dead, have been thorough working and walking men. Some of them have related to us curious and amusing incidents of their pedestrian tours and hammering handicraft. Old Father Smith, or "Stratum Smith," as the author of the first complete geological map of England was called, has enlivened many an hour of our boyhood by his never-failing fund of rambling reminiscences. He had walked over a great part of England, snapping and hammering; and, being the first who had gone abroad in this position, was frequently misunderstood. Sometimes he was commiserated as a poor escaped lunatic, sometimes as a searcher for gold, sometimes as a foreign spy, and at other times for a poacher, or a conjuror, or a showman, or a grotto-maker. His first meeting with Professor Sedgwick was upon horseback, with a stout boy behind him, and a couple of deep saddle-bags; the boy being hired as guide to a "mine of sugar candy," which Smith knew to be sulphate of barytes. Smith once left a box in his lodgings at Bath, which he strictly and solemnly charged his landlady to watch over with jealous care, and on no pretence whatever to permit it to be opened until his return. What woman could resist the temptation to peep into a box so mysterious? Certainly not Smith's landlady. But when she had yielded to the impulse of her ungovernable curiosity, and found only a heap of old and odd stones, she was so offended at the supposed hoax, that out of doors went the box, and in doors its returning owner was scarcely permitted to come. "What did he mean by playing such a trick to a poor lone woman?"

Another good story is that of one of our most eminent and ardent living geologists, who, being invited by a nobleman to meet some fashionables at dinner, occupied his morning by investigating the heaps of stones at the sides of the road which led to the park gates. While sitting on one heap and hammering very hard, a lady of rank, one of the bidden guests, rolled by in her carriage. The professor touched his hat, and immediately the lady, mistaking the meaning of his movement, threw him a shilling! After dinner that day the delighted professor returned to his fair but deluded neighbour at table, whom he had been entertaining in his best manner, the *shilling*, with thanks and mock gratitude.

Without going beyond the records of our own experience, I might fill many pages with similar amusing incidents, which rise up vividly to recollection as I cast a momentary retrospective glance over past summers of wayward wanderings from quarry to quarry. Near Stonesfield, in Oxfordshire, I was a year or two ago, walking home with a gentleman who had accompanied me to the slate or stone pits, and worked with me for fossils. We had obtained, by purchase and personal labour, a bagful, and as my friend was kindly taking his turn in carrying the full and heavy bag across some out-of-the-way country, he missed the right road. Stepping up to a cottage door in a little hamlet, he knocked for the purpose of inquiring the right way, but was rather abashed when the careful though uncivil housewife opened the door, and casting a suspicious glance upon my dusty friend, exclaimed, "No, I don't want nothing to-day. Go away; I won't have nothing at no price!" Never shall we forget the indescribable look of our friend. At first he could not laugh; but at home, and after tea, we laughed long and loud at the ill compliment paid to a son of science, and the indignity done to a bag of precious fossils.

I could also relate some curious conversations with quarrymen respecting the nature of fossils, and some vexatious mistakes which have placed me upon wrong scents, and seduced me many a weary mile to no purpose. In the Wealden district of Sussex, for example, I once heard that one of the navvies, in a railway cutting, had found "Noah's breastplate." What this could really be, by no stretch of imagination could I conjecture. Away, therefore, I went, over hill and down vale, and through strong clay fields for long miles, in search of "Noah's breastplate." Fatigued and heated I arrived among the navvies, and, after stating my desire, one of the hulkiest fellows was shouted for. Full of the importance of his discovery, he led me to his mud-hovel, and after due pauses and sundry sad exaggerations of the value of his treasure-trove, he at length produced the said Noah's breastplate, which proved to be a few large, shiny, lozenge-shaped scales of a lepidote, a fossil fish well known in the Wealden beds. Five sovereigns was the least our friend would take for Noah's breastplate. Upon rashly offering five shillings, its full worth, I was summarily and indignantly ejected, and Noah's breastplate was restored to its ark, an old wooden box. The reader is assured the navvy's nomenclature was such as we have given it.

I believe I could make a small volume of such geological experiences, and I will venture to say my brethren of the hammer, who may have walked as far and as frequently, could add to its stores. We have piscatory colloquies and anecdotes, which seem greatly to delight anglers, from the days of Walton and Cotton downwards; why should we not have geological incidents and experiences? Why should they die out with the men who have been the subjects and narrators of them? Some day, perhaps, ere I myself become a fossil, I may attempt to gather together such a *Lapidosa Curiosa*, and meanwhile invite contributions well authenticated.

My present purpose is to indicate, to young and less practically informed geologists, the most suitable places for brief sojourn, and excursions from large cities, the best methods of reaching them, and the most convenient centres of abode, together with particular quarries and strata, and more especially the fossils to be found or sought, with some notices of local collections and collectors. This is a kind of knowledge only to be acquired by experience, and unfortunately oftentimes at the cost of continual disappointments and fruitless labours. I have to regret much lost time from the lack of the needful information previously to departure, and I have generally found that none but those who have worked locally for themselves can give accurate information. By taking a district at a time, and throwing together such notes and recollections as come to hand and mind, without pretension to a scientific mode of treatment, and with a ruling desire to allure others into the same pleasant and profitable excursions which have afforded me so much undying interest, I hope to be of service to the rising race of geological students, and especially to that large and increasing class who earnestly seek an opportunity of acquiring health for the body and food for the thoughts at the same time, and by the same recreative excursion.

Amongst all the fields for fossil-hunting, and the investigation of strata, none occurs to us as more suitable for our first essay than the Cotteswold hills and vales. They are easily and speedily reached by railway, and two or three important towns lie amidst them. They present an assemblage of very interesting strata, generally rich in fossils, and comprising some of the best typical examples of rocks and petrifactions. Moreover, the beauty and variety of the scenery, which they themselves constitute or encircle, is such as can scarcely be surpassed amongst the secondary rocks of England. We have lingered for many sunny hours upon their slopes and summits, and upon their frontal battlements, gazing on a long winding river, or far grassy and rocky hills, or down upon clothing mills and factory cottages, nestling under oolitic prominences, and we have stood and watched the railroad trains winding through the cuttings of inferior oolite or clay, and steaming down into the confluences of valleys once washed by the whelming waves.

For nearly three years have I found pleasing heights and haunts, and retired nooks and profitable excavations, in these hills, and I must have perambulated more than one hundred miles amongst the Cotteswolds with hammer and bag, adding the walks of season to season; whilst I must have carried, in all, some hundredweights of fragments of rock on a back hardly broad enough to bear the burdens of life, much less the burdens of consolidated mud and sand, with imbedded shells, which zeal for a favourite pursuit had accumulated at the quarry's edge. Some prosaic folks would think the present contents of my cabinet hardly equivalent to the expenditure of time and toil requisite to their acquisition, but no one will deny that an improved state of the stomachic functions is well purchased at even a more profuse expenditure, while all who have any love for scenery will allow that when memory becomes a gallery of natural beauties and exceeding loveliness, and when every fossil suggests its original quarry, with its surrounding glimpses of remote woodlands, and rolling waters, and rising hills, and rounded promontories—then time could hardly have been better spent, or toil more richly rewarded. Many plain commercial people might be disposed to adopt some lines put into their mouths, and sing:—

> "Tho' fossils once were shells and bones,
> Now at the best they are but stones."

We should add, for our own parts, and in self-defence:—

> "So richly storied are these stones,
> So full of meaning—shells and bones.
> So far remote their primal age,
> So pregnant ev'ry rocky page
> With mighty lore—that none can fail
> To learn from their deciphered tale
> How wide the sphere, how brief the span
> Of frail and mean, yet mighty MAN."

Any pedestrian who wishes to ramble over the Cotteswolds, can reach them rapidly by railway. The Great Western line will convey him to Cheltenham, Gloucester, or Stroud, and either of the three will form good starting stations. After many rambles he will find out for himself their physical geography and geology, which may be thus condensed.

The hills, properly so called, consist of a number of eminences, of greater or less heights, rising out of a long chain. Some of these are of considerable altitude. Cleeve Cloud, not far from Cheltenham, rises to a height of 1081 feet; Leckhampton Hill, which overlooks Cheltenham, and presents it to great advantage to the spectator, is 978 feet high; Birdlip Hill, a little further on, attains 969 feet; Painswick Hill, 929 feet; and Stinchcomb Hill, near Daisley, 725 feet; while on the same frontal range, Uley Hill (locally Uley Berry) attains 823 feet, and Frocester Hill 780 feet. The three last-named eminences (Stinchcomb, Uley, and Frocester) afford views over the Severn, and include a wide expanse, the beauty of which is very remarkable. We have visited the two latter at least eight or ten times, and we can honestly say we never found the scene pall upon us. Geology and the journey from London would be well repaid by a view, on a favourable day, from these summits. Englishmen do not know half their scenic treasures. Many a foreign prospect of celebrity would suffer by comparison with what is to be found here. Stinchcomb takes in most of the course of the Severn, but Frocester and Uley equal, if they do not excel it, in various combinations. We have been informed that the celebrated dissenting preacher, the late Rev. Robert Hall, when conveyed to Uley Berry, upon alighting from the carriage, and gazing around for a few moments, fell upon his knees, and gave thanks aloud to the Beneficent Creator for the exceeding beauty of the scenery. Nor do we think this unlikely, extravagant as it may sound, from what we ourselves have heard from the lips of that great man, that master of pulpit eloquence, while accompanying him, in our boyhood, upon country excursions.

Geologically, we see that the entire region constitutes a distinct marine area in the ancient Jura * sea of England, now marked only by its oolitic rocks and organic remains. Restoring its primæval hydrographic condition in imagination, we can detect, in the north-eastern extension of the area towards the midland and northern counties, the gradual change of the several deposits, and of the organic remains; while the transition is abrupt in the opposite direction, towards Somersetshire. The carboniferous rocks of the Bristol Coal-field nearly sever the connection between the Cotteswold and the more southern area. In the Cotteswold Hills, then, we have a distinct ancient marine province of the lower oolitic seas; and here we have a naturally distinct field for special geological research, one which, if fully studied and personally examined, would of itself suffice to afford a good groundwork of geology for any student.*

Beginning at the outer escarpments of this range of hills, we discover them to be composed of inferior oolite and lias, and to present low headlands along the vales of Gloucester and Berkeley, rising, in some instances, to the altitude just mentioned, and extending in a tortuous line from north-east to south-west. In fact, they constitute the eastern boundary of the Severn, and the city of Gloucester and the town of Cheltenham lie in bays at the foot of this range, the base of which consists of lias, surrounded by a variable thickness of oolite. The uppermost rock of these hills is the great oolite, but the upper beds are absent from a large portion of the area occupied by it. When entire, its thickness is about 150 feet. It does not extend to the outward escarpment, but forms throughout the Southern Cotteswold, at some little distance in the rear, a step-like elevation, which is altogether removed from view in the western vales. Following the course of the transverse valleys into the mass of the hills (as, for instance, from Stonehouse), the steep slopes are discovered to be crowned by the great oolite, so that we may ascend the geological stairs in our natural course from Stonehouse or Frocester, near which places there are railway stations. Alighting and ascending from Frocester, and walking over to Minchinhampton Common, we in fact perform a geological gradation. That this may be clearly understood, we present a tabular abstract of the strata in this area, in their descending order, from the surface of the

* The terms Jura and Jurassic are now universally employed by continental geologists, and frequently by English geologists, to include and denominate the lower oolitic and lias rocks, of which the Jura range of mountains in Switzerland is composed. Of these the Cotteswold Hills are the English representatives. The one word Jurassic is convenient, and therefore in frequent use. But another English term, Bathonian, is more recently adopted by some in a wide application, the strata at and around Bath being less comprehensive.

* Parallel studies may be found in the Caen stone quarries in the North of France, and Solenhofen in Germany. The Oxford slates and quarries of Portland are notable examples of English oolite.

ground, and add to each bed the names of the principal places where it prevails.

OOLITIC SYSTEM.

LOWER OOLITE SERIES IN THE COTTESWOLDS.

Beds.	*Principal Localities.*
Cornbrash and its Clays	Near Cirencester.
Forest Marble	Ditto.
Bradford Clay	Tetbury Road.
Great Oolite	Minchinhampton.
Stonesfield Slate	Levenhampton, Eyeford, Bisley.
Fuller's-earth	Wotton Underedge.
Inferior Oolite	Leckhampton, Frocester, Rodborough.

LIASSIC SYSTEM.

Upper Lias Shale	Vale of Severn and Base of the Cotteswold Hills; Base of Leckhampton Hill; here, in all, 759 feet estimated thickness.
Marlstone	
Middle Lias Shale	
Lias Limestone	
Lower Lias Shale	

The whole of the above series may be comprehensively termed the Jurassic series; and nowhere in England have they a more typical development, on the whole, than here, although in other places they may, in *part*, be occasionally more widely extended.

The two chief sources of springs of water in these hills are, first, the base of the great oolite, at about the Stonesfield slate, or the junction with the fuller's-earth; and, secondly, to the base of the upper liassic sands, or in cases where they are absent, the base of the inferior oolite. It is interesting to know that from this latter geological position *the river Thames rises*, at the spot called Seven Springs, near Cheltenham, from which town it is a pleasant pilgrimage. The necessary condition of the water-bearing strata is the superposition of porous strata through which the rain and snow-water may gradually filter to the receiving and retentive stratum below.

Gloucester and Cheltenham are partly supplied with water from these perennial fountains: Gloucester, by collecting the rills which trickle down Robin's Wood Hill, and guiding them to reservoirs situated on the north side, near its base; and Cheltenham, by adopting a similar method with the water which reaches the surface of the base of the oolite and underlying sands, along the flanks of Hewlett's Hill. These are collected into a reservoir on Battledown Hill, about 150 feet above the town itself. The saline springs, however, for which Cheltenham is so famous, differ in many respects from the waters just noticed, and are differently derived.

This topic is well treated in Mr. Hull's "Memoir of the Geology of the Country around Cheltenham, illustrating Sheet 44 of the Geological Survey."

I now give an outline of *agenda* and excursions from Cheltenham, Gloucester, and Stroud, or Nailsworth, as centres or head-quarters, founded upon my own experience, and upon the supposition that my readers are tolerable pedestrians and zealous geologists.

CHELTENHAM.—Inspect Dr. Thomas Wright's collection of fossils, which is remarkable for its probably unequalled series of *Jurassic echinoderms*, which the Doctor has made his particular study. Visit Leckhampton Hill, and verify the section given. Search the bed No. 7, named Pisolite, and by Murchison, Pea-grit, for small *Cidaridæ*, which are often beautiful, but seldom entire. Here it is thirty-six feet thick; at Crickley Hill, forty feet thick. The higher beds at Crickley contain many fossils not well preserved—mollusca mostly denuded of shell. No less than twenty species of echinoderms have been derived from the pea-grit of Crickley, Cleeve Cloud, and Leckhampton. Every piece of pea-grit should be examined.

Visit Cleeve Cloud; search for fossils in all the formations. Trace the oolitic marl, which may also be found at Miserden and Sudeley Hill. All these localities contain fossils in the yellow-white marl.

The freestone beds contain numerous shells, but they are very difficult to light upon casually, and hard to clean and detach. Local cabinets contain several, but they have been procured at great cost of time and labour. The casual visitor to the freestone might infer that it was barren of organic remains. A resident might extract a good series from its 100 feet of thickness.

Birdlip Hill, a few miles further, affords good *Terebratulæ*, etc. For a few days Leckhampton and Birdlip would afford ground enough. They are, however, well searched over by residents.

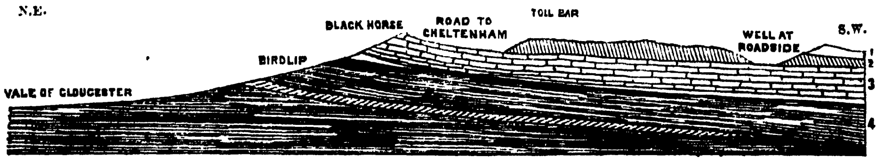
A rough sketch of a section of part of this neighbourhood (Fig. 1) will enable the reader at once to ascertain his geological position.

The shortest way of getting the common fossils is to repair to one or other of two local collectors, father and son, named Jenkins, at Cheltenham. I have dealt with Thomas, the father, and found him attentive and reasonable; he would indicate localities, or send a man as guide. As to cost, it would be far cheaper to purchase of him, but he may not have good specimens at hand.

While in the town, the best maps and books should be procured, if not before. The Ordnance Survey Map, Sheet 44, geologically coloured (sold at Jermyn Street, London, and by Stanford, Charing Cross), includes Cheltenham and East Gloucestershire. It is, perhaps, on too large a scale for the pocket. A more portable, but less valuable, map was previously published by Professor Buckman. Amongst books, there is Murchison's "Geology of Cheltenham," last edition, containing figures of fossils.

Two or three gentlemen at Cheltenham are collectors, and have good cabinets. The hasty visitor will learn more at Cheltenham than elsewhere in a short time.

The subjoined section of Leckhampton Hill (Fig, 2) will facilitate research:—



1. Great Oolite. 11. Fuller's Earth. 12. Inferior Oolite. 13. Lias.

FIG. 1.

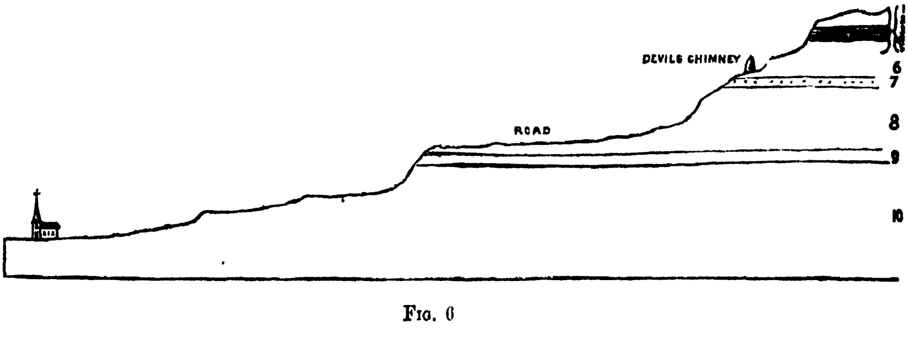


FIG. 6

DESCENDING ORDER OF STRATA AT LECKHAMPTON BEDS.

	Thickness. ft.	in.	
1. Trigonia grit	7	0	Inferior Oolite. 230 feet.
2. Gryphite grit	7	0	
3. Bubbly oolite, with many fossils	24	0	
4. Fragmentary oolitic freestone, unfossiliferous	26	0	
5. Oolite marl, containing Terebratula fimbria	17	0	
6. Freestone, quarried for building, with shelly layers, as in regular intervals. The thickest and most fossiliferous portions at its base	106	6	
7. Pisolite, or pea-grit, and ferruginous oolite (belemnite bed) and sand	42	0	
Upper lias, about 160 to	180	0	Liassic Beds. 749 feet.
Marlstone, about	50	0	
Lower lias (probably 600 feet)	519	0	
Total height of hill above the sea level	979	0	

All the above beds require and repay separate study and elucidation, which we cannot at present find room for; but they are of considerable interest, especially with reference to the fossils found in them.

Crickley Hill (which is well worth a visit) may be compared with that of Leckhampton:—

	ft.	in.
1. Pisolite, with small admixture of oolitic ragstone	5	0
2. Freestone, including pisolite	9	0
3 Hard blocks of oolite, consisting in part of very indurated pisolite	35	0
4. Sandy oolite, occasionally pisolitic	25	0
5. Lias	0	0

Gloucester.—Examine Mr. John Jones's collection. Mr. Jones is a good geologist, and highly intelligent. The best localities for collecting Jurassic fossils, starting from this city, are Frocester Hill, Naresfield Hill, and Cooper's Hill. For the oolitic freestone, visit Painswich Hill, Birdlip, and Horsepool Hills. For the fimbria beds, the gryphite and trigonia grits, visit Horsepool, Naresfield, and Cooper's Hills. At the latter place, *Terebratula globata* is abundant, but not in sites.

The lower lias may be studied at Purton Passage, at Tretherne, at the Berkeley Canal banks, and at the brick-pits near Llanthony, etc.; the marlstone at Churchdown Hill, Robin's Wood Hill, etc.

Further researches may be made down and up the Severn, but hardly come within our present scope.

Stroud, or Nailsworth.—The latter preferable, and about four miles from Stroud, by omnibus, or by a beautiful walk through one of the most interesting valleys in the county, and, perhaps, in England. So King George III. thought and said. Both places take much the same district. If starting from Nailsworth (a village among the clothing-mills, and where there is comfortable accommodation), several valleys branch out in various directions, all of more or less geological interest; that leading to Horsley least geologically interesting. Perfect *Terebratulæ* may be gleaned from the waterstones, and a few small pits on the left-hand side of the Shortwood Valley—one near the Shortwood Chapel. If time be short, omit this direction any further than Shortwood Valley, and go in opposite course to Nailsworth Hill. Here some old openings at the roadside leading to the Common afford a few fossils. Travel up Scar Hill, and look at the *debris* of the freestone. Generally, the freestone hillside quarries, where men are working, afford very few fossils indeed, not worth a visit for them. When on "the Common" examine the quarries, and especially make for the great oolite beds developed in two adjoining quarries, near the middle of the Common, marked by an old finger-post. These are called Chalkley's Quarry, from the man who works them. They have produced the large and highly interesting assemblage of fossils known as the

Minchinhampton series, and as collected and described by Mr. Lycett, a surgeon of Minchinhampton town. The best method will be to make an appointment to visit and study that gentleman's important and illustrative cabinet. No other in the county, or indeed anywhere, contains so interesting and complete a series of the great oolite testacea. Minchinhampton is about two miles from the quarries, and conspicuously marked by its church tower.

In returning to Nailsworth, the tourist may vary his walk by striking down into another valley, by the plane of Longford's mills, or go to Rodborough, across the common, and thence down into Stroud; or he may go from Chalkley's Quarry down the road to Brinscomb, where there is a railway station. Starting from Nailsworth, or Stroud, or Rodborough, there would be walking and running enough for a week or a fortnight. One of the best little inns for the Minchinhampton Common district would be that called the Bear, on the Common, and not far from Rodborough. The people who keep it are civil and respectable. It is isolated, but very convenient to a geologist, and the situation is remarkably healthy.

We have thus indicated as much as might be, in outline, but we should have very much to say on the almost unrivalled series of oolitic fossils already derived, and probably still derivable, from this beautiful district of the Cotteswold Hills. Almost every wall, and certainly every quarry, has borne the marks of our hammer.

At Cirencester, the cabinet of Professor Buckman is select and interesting, and the Agricultural College contains a superior general museum.

A few Cotteswold fossils, forming part of general collections, may be seen in the Jermyn Street Museum, and the British Museum, London. The Woodwardian Museum at Cambridge possesses an extensive collection of the testacea of the great oolite of the Cotteswolds. If we add our own cabinet, and that of the Rev. P. B. Brodie, Rorington, near Warwick, we believe we shall have enumerated the best public and private collections of Cotteswold fossils.

J. R. Leifchild, A.M.

A CHAPTER ON FLIES' HEADS.

"O happy living things, no tongue
Your beauty can declare;
A spring of love gushed from my heart,
And I blessed you unaware."—*Ancient Mariner.*

Summer come at last, after the longest, dreariest winter we have known for many a year; summer in the quiet, beautiful country, after the noise, the confusion, and the influenza of London; summer in the garden, where the apples are ripening and the hollyhocks are blooming amidst a throng of gay companions. Who does not know the thrill of grateful gladness with which we wander forth to count our flowers, and rejoice in the sight of their old familiar faces?

Flowers are our home friends even from our childhood, and there is little need to urge any true heart to love *them*; yet not long ago, in the pages of this work, some handfuls of the wild ones were made dearer by an insight into their life's history. We scarcely feel a deep interest in any unknown thing or person, however much we may admire them generally; and whilst the beautiful colour or form of a flower attracts and pleases, that admiration and pleasure is increased tenfold by a knowledge of its structure, order, use, and of the life circulating within. So there are other little friends in the garden and in the field which we notice generally, but pass by uncared for because so little known, and yet which throng our path with beauty and our atmosphere with usefulness.

I thought of this as I lingered in the garden one sunny day last week, and saw, resting on a sweetbriar leaf, a small-winged emerald, the beautiful *Dolichopus* fly, very common in our neighbourhood, and everywhere near ponds and rivers. Presently, on a laurel close by, my favourite little *Sepsis* alighted, and, after its usual fashion, ran to and fro upon the leaves, with quivering, uplifted wings rejoicing in the sunshine, and probably moved by instinct, equally rejoicing in the deposit of its tiny eggs. The bird cherry-tree was just unfolding its white blossoms, and they are ever a rich pasture-land for the insect tribe. I turned towards it, and saw a hovering, darting, glittering thing, with bands and spots of gold variegating the black body. It looked like a small wasp, but I knew it to be a *Syrphus*, one of the honey-loving flies, whose ecstasies seem to be too great for steady flight, the vibration of its wings beating a thousand strokes a second, and the very act of flying being the palpitation of its joyous little heart.

On the same blossom, amidst a host of small beetles, ants, and bees, were numerous fierce little flies, called *Empis*, with long needle-shaped upper lip or labrum, upon which a smaller fly was transfixed, whilst the long-curved tongue was leisurely lapping up the life-blood. Just then pounced heavily down a couple of *Scatophaga*, or dung-flies, the female busily eating up a little chlorops, and so on, the numbers of my acquaintance increasing every moment, to my great interest and amusement.

Heads of Tipulæ.

These little creatures, which for some years I have sought and studied, came to me with the friendly remembrance of by-gone times, and with the welcoming of another summer. They were not strangers; I knew where each had come from, what each was doing and intended to do. I felt that they were fellow-servants with me, having an appointed place in creation and content therein, an appointed work to do and doing it faithfully. It was then that I bethought me how little is known of these pretty insects, how little they are appreciated; we could as easily do without flowers as without flies, so useful are they in the economy of life, and it would be both pleasant and easy to learn enough of their history and individuality to make them our wayside and window-pane friends.

Without entering into the difficulties of a

1. HEAD OF ASILIS, a fierce, blood-thirsty fly, his ready tongue outstretched under its lancets, and his antennæ, the organs of smell, erect and forward.

2. HEAD OF XYLOPHAGUS, a near relation to the former, but of indolent nature, and oftener at rest on the old gray trunk of a tree than out upon a foray, like his cousin Asilis.

3. A very wide-awake young fly, but a honey-loving, flower-haunting little fellow, extremely handsome and happy, being one of the vibrating Syrphidæ, called Ceria. He carries his antennæ very jauntily.

4. HEAD OF VOLUCELLA, a matter-of-fact fly, whose practice it is to provide for its young by securing it a berth in the nest of a wasp or of a humble-bee. The feathered antennæ are very sensitive, and the profile indicates thought and caution.

5. HEAD OF ZODION. } Both these are nearly re-
6. HEAD OF MYOPA. } lated evidently; they are harmless, feeding on decaying substances, and depositing eggs in the bodies or nests of other insects; parasitical in their habits, enjoying whatever they can get, smelling far, and tasting long.

7. HEAD OF MUSCA VOMITORIA, or BLOW-FLY. The largely-developed antennæ and tongue, with our knowledge of its troublesome pranks in our larder, renders further description unnecessary; the sly retreating forehead gives promise of the acuteness that finds out the snuggest corner in a bone, the juiciest furrow in a fillet, to deposit its unpleasant little larvæ.

8. HEAD OF MUSCA RUDIS, a quiet, good-natured fly, who sleeps all the winter in the crannies of our walls or the chinks of the window-sill, and comes forth first of all the flies to stretch his wings in the brief sunshine of March. He is heavy, with reddish cheeks and black whiskers; enjoys a little honey or a tit-bit of decomposing matter, but is in no wise a remarkable character.

9. HEAD OF SCATOPHAGA, or DUNG-FLY. This face hardly expresses its predacious habits; the antennæ are large, like those of the Blow-fly, which enables it to smell the newly-fallen dung, which it haunts to deposit eggs.

10. HEAD OF PLATYCEPHALA. Not a common fly, nor a common character; it is related to the mischievous family of Chlorops, who meddle with our barley and wheat, and give them the gout; but I really do not know anything of the habits of Platycephala.

11. Here is the jaunty little head of LOXOCERA, who may be found very commonly on the field mallows or clumps of nettles; a pretty, long-bodied, red and black fly, very harmless and weak-minded, I should say, by the toss of his head, sniffing the air, and smelling the wrong way, for his food is in the flower-bells.

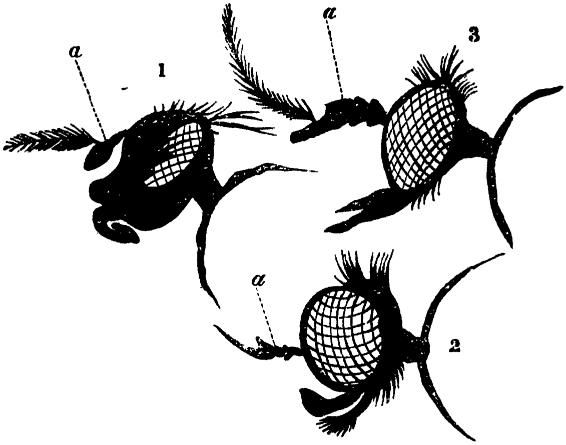
scientific recognition of the species, it quite suffice for our recreation and knowledge of the Diptera, or two-winged flies, to learn their two large groups first, and then the principal genera, which will not involve any deep study, or the learning of harder names than those of our own garden flowers. There is often a frightened shrinking from scientific names, as if they were impossible to remember; but truly I find that Dolichopus is as easily pronounced as Nemophila, Scatophaga not more difficult than Calceolaria, and Empis, Sepsis, Leptis are easier far than Hyoscyamus, Antirrhinum, Pelargonium, our commonest flower names.

I therefore begin my introduction to the Diptera by explaining, that flies are distinguished one from the other by the variation of the antennæ and the veining of the wings. The two great groups are the *Nemocera* and the *Brachyura*.

The *Nemocera* comprises all the *Tipulæ*, gnats, midges, etc., which have long antennæ, from six to sixteen joints, inserted in front of the head between two large, compound, facetted eyes. There is no more beautiful object for the microscope than the head of a Tipula well prepared. The lace-work eyes are of fine purple colour, the delicate antennæ showing every joint, the palpi bending over the fleshy proboscis, in which large trachea are distinctly seen; and the study of a head so mounted will teach more than any drawing that can be made.*

The second group, *Brachyura*. These have the antennæ short, usually from three to six joints, but never exceeding ten. The observation of the antennæ with a pocket lens will easily determine the fly's position in life. As an example of the *Brachyura*, look at the head of the common blow-fly, or the *Musca domestica*, house-fly, the *Tabanus* and *Dolichopus*.

It would scarcely be imagined what variety of form and expression there is in the



1 Blow fly. 2 Tabanus. 3 Dolichopus.
a, a, a, antennæ.

profiles of flies; I have selected a few, by no means the most remarkable, to show what a little observation will discover.

L. Lane Clarke.

Woodeaton Rectory, Oxford.

* Prepare it thus:—Cut off the head of a Daddy-long-legs, soak it in diluted liq. potassi for a week or ten days; then wash it in cold water, and press in a proper position between two pieces of glass until quite dry; drop a little turpentine upon it, and they will mount beautifully in Canada balsam.

BAROMETERS FOR THE COAST.

When storms strew our coasts with wrecks, we are reminded that by the use of the barometer many such disasters might be avoided. What a noble work for philanthropy to distribute barometers, with instructions for their use, among the humbler class of coasters, by means of a society formed expressly for the purpose!

COMET III., 1860.

TOWARDS the close of June, a fine comet suddenly made its appearance in the northern heavens. From its position and considerable size, it was anticipated that it would turn out to be the celebrated comet of 1556, whose return to perihelion is looked for during the present year. Such, however, is not the case, this comet being one which, as far as we know, has never before been seen in these regions of space.

The comet seems to have been first noticed in France, on or about June 19th.

On June 22, Dr. Donati, the distinguished Florentine astronomer, considered its nucleus to be equal almost in brightness to that of a star of the first magnitude, and that its tail was 15° long. On that day the comet, which passed its perihelion six days previously, was receding from the sun, and was distant from that luminary 33,000,000 miles, and from the earth 84,000,000 miles. The absolute length of its tail was, therefore, on that evening, rather more than 22,000,000 miles. It was in the constellation Auriga, in the vicinity of α and β.

On June 24th, the comet had reached the border of Lynx, and its approximate position was as follows :—

G. M. T.	R A.	Decl.
11h. 30m.	6h. 50m.	+ 43°

The nucleus was hardly so bright as on the 22nd, probably not exceeding that of a star of the second magnitude; the length of the tail was about the same. The comet was so situated as to appear rather above a line drawn through α and β Auriga and W. of β, by about the same distance that β is W. of α.

On June 27, in consequence of its southerly movement, it had become somewhat entangled in the twilight, and the visibility of its tail was impaired.

On June 29, its position was as follows :—

G. M. T.	R. A.	Decl.
10h. 30m. 5s.	7h. 49m. 56s.	+ 39° 20′

After this night the comet ceased to be circumpolar, and therefore not visible before sunrise, but only after sunset.

On July 1st the comet was hardly perceptible to the naked eye, in consequence of the joint influence of the twilight and the moonlight. Its nucleus was not brighter than that of a star of the fifth magnitude, and its tail very much reduced in apparent size.

On July 5th the comet was in Cancer, its exact position being :—

G. M. T.	R. A.	Decl.
0h. 0m. 0s.	9h. 2m.	+ 29° 46′

It was distant from the earth 50,000,000 miles.

On July 10th it was in Leo, very near the bright star Regulus (α Leonis), mag. 1, and distant from the earth 45,000,000 miles.

On July 11th it crossed the ecliptic, into the southern hemisphere at a point 21° behind the planet Venus.

The following are the elements of the comet, placed in the order adopted in the catalogue lately published in RECREATIVE SCIENCE :—

P.P.	1860, June, 16d. 12h.	G. M. T.
π.	162° 29′	
δ.	83° 58′	
ι.	79° 22′	
q.	0·29874	
μ.	+	

Calculator, J. R. Hind.

These elements bear no resemblance to those of any comet yet known.

G. F. CHAMBERS.

Eastbourne, July 17, 1860.

ALUMINIUM BRONZE.

THE production of aluminium has already reached a stage of development, which renders it possible to apply it to purposes much more extended than was thought probable for some time to come. It was thought that the manufacture of jewellery and plate would consume all that could be procured for another year or two at least; and that the cost of the metal would preclude its being used for any grosser purposes at present. On this point, however, speculators are likely to be mistaken, if we may judge from the information contained in a letter to M. Dumas, and inserted in a late number of the *Comptes Rendus*. The letter is by M. Christofle, who writes:—"We have applied the *bronze d'aluminium* (aluminium bronze) to two uses for which its hardness and tenacity seemed specially to fit it; and the success has fully answered our expectations. The first is in the construction of boxes for rotating axles, bearing surfaces for slide valves, and so forth. For example, the journals for the axle of a polishing wheel, making 2200 revolutions a minute, were made of aluminium bronze: they have been in use now for eighteen months, and were not unfit for further use till the expiration of that time. Boxes of ordinary bronze, under the same conditions, would not have lasted more than three months. Again, the sliding bars of a sawing machine, the saw moving with a velocity of 240 revolutions a minute, were made of the same alloy. They have been in use now for a twelvemonth without exhibiting any trace of wear. Bars of ordinary bronze would not have lasted more than four months.

"The second application of aluminium bronze is its employment in the manufacture of cannons, gun-barrels, and other fire-arms. We have had a pistol-barrel made of it in our factory, which, after being tried in the practice-ground of Renette, near Paris, was sent to the exhibition at Dijon. There it was subjected to a variety of tests in the presence of the jury, where the results answered our most sanguine expectations. It must not, however, be supposed that this trial of a single barrel can prove conclusively its adaptability to the purposes of artillery; but the comparative experiments made by us between this metal, ordinary bronze, iron, and steel, have demonstrated its great superiority over the other metals, and our convictions on this point are so profound, that we have requested the Academy to support our application to the Minister of War to be permitted, at our own expense, to construct such a piece of artillery as may be thought most suitable for testing the properties of aluminium bronze as a metal for ordnance. We look for great improvements in this direction, improvements with which we shall feel proud and happy to have our name connected, while ready to render all homage to that of M. Henri Sainte-Claire-Deville, to whom is due the discovery of those alloys for which apparently so brilliant a future is reserved.

"The large bar deposited in the office of the Academy is intended to be forged and bored for a Minie rifle. The small bar has already been forged at a cherry-red heat, at which it works like steel of the best quality, whilst it is well known that ordinary bronze is brittle when heated."

Besides the pieces mentioned in the letter, several casts of sculpture were submitted to the inspection of the Academy, and M. Christofle's communication was referred to the examination of a committee composed of Marshal Vaillant and Messrs. Piobert and Morin.

RICHARD BITHELL.

IS THE MOON HEATED BY THE SUN?

The idea that perpetual snow exists on high mountains, because the air is less dense than at the surface, is quite a mistaken one. The rarity of the atmosphere may have a comparatively slight effect by facilitating radiation (that is to say, by removing sources of counter radiation); but no doubt exists as to the principal cause of cold on high mountains being the removal of the summits to so great a distance from the heated surface of the earth, and the heated strata of air upon or near its surface, which rise, indeed, but cool as they rise. The snow-line rises higher by some thousand feet on the northern slopes of the Himalaya, though turned away from the sun, than on the southern slopes, because the gently elevated table-land of Thibet stands to the former in the relation of the general surface of the earth. The coldest regions on the general level of the earth have the densest atmosphere, because—omitting the slight increase of gravity towards the poles—they *are* the coldest, and the tropical regions have the *rarest* atmosphere. If the sun had no direct heating effect upon the earth, the tropical would be no warmer than the arctic regions, or little more so, because the obliquity and consequent paucity of the sun's rays, incident on the earth's surface in high latitudes, would have comparatively very little effect upon a medium which, like the atmosphere, *transmits* the calorific rays instead of absorbing them, as the surface of the land does, and in a less degree that of the sea. It is on the summits of high mountains that, however cold the atmosphere, the direct rays of the sun have the *greatest* heating power on solid substances. It is only near the summit of Teneriffe that any sensible radiations of heat from the moon have been obtained.

The absence of atmosphere on the moon would *increase* the heating power of the sun upon its surface, for three reasons: there would not be that partial interception of the heating rays which an atmosphere occasions; there would not be the more potent cause of cooling in the convection of atmospheric strata successively heated on its surface, and carried upwards; and, as there would be no moisture, there would be no evaporation. On the other hand, there would be more radiation, and, consequently, more rapid cooling in the absence of the sun; but during the continued presence of the sun, that increase of radiation would itself promote the heating influence of the moon upon the upper portions of our atmosphere, in connection with which as probable—and the experiments on Teneriffe appear to prove the actual fact—the heating of the moon is mentioned by Sir John Herschel in his "Outlines of Astronomy." The *fact*, indeed, of heat being received from the moon would not show whether it is the result of radiation or reflection; it may be the result of both. But your correspondent's idea of its being the result of the latter, as from a polished reflector, not itself heated, would scarcely be realized by a *convex* reflector, even supposing that it had a polished surface, instead of a rough and powerfully absorbing and freely radiating one, as the moon most likely has.

It should be mentioned that the resistance of snow to the great heating power of the sun on lofty summits is owing to its perfectly white colour—one of those innumerable beneficent provisions which so strongly argue Providence in the constitution of Nature. With black snow, in mountainous parts of continents, the lowlands would be alternately submerged in water, and, the sources of their rivers being removed, comparatively waterless and arid wastes.

J. H. K.

METEOROLOGY OF AUGUST.

FROM OBSERVATIONS AT HIGHFIELD HOUSE OBSERVATORY.

—o—

Year.	Mean Temperature of the Air. Degrees.	Mean Temperature of the Dew Point. Degrees.	Mean Pressure of the Air. Inches.	Mean Amount of Cloud. (0—10).	Number of Rainy Days.
1846	65·3	56·8	29·895	6·7	16
1847	63·1	56·6	29·873	4·9	10
1848	57·6	51·8	29·701	6·3	25
1849	60·2	56·5	29·831	7·3	20
1850	57·9	54·4	29·770	5·6	17
1851	59·7	53·7	29·909	6·4	14
1852	61·2	54·7	29·646	6·5	23
1853	57·6	50·4	29·874	7·2	10
1854	59·4	53·3	29·852	6·2	15
1855	60·7	55·8	29·809	6·0	14
1856	62·4	54·8	29·718	6·5	18
1857	63·2	56·9	29·843	7·2	10
1858	62·0	50·6	29·799	6·7	19
1859	61·7	55·3	29·774	6·1	14
Mean	60·9	54·4	29·811	6·4	16

The mean temperature of the last fourteen years is 60·9°, the range in the mean temperature being from 57·6° in 1848 and 1853 to 65·3° in 1846, a difference of 7·7°. The lowest means occurred in 1848, 1850, and 1853, and the highest in 1846, 1847, and 1857.

The mean temperature of the dew point of the last fourteen years is 54·4°, the range being from 50·4° in 1853, and 56·9° in 1857, a difference of 6·5°; the lowest means occurring in 1848, 1853, and 1858, and the highest in 1846, 1847, 1849, 1855, 1857, and 1859.

The mean pressure of the last fourteen years, at 174 feet above the sea, is 29·811 inches, ranging between 29·646 in 1852, and 29·909 in 1851, a difference of 0·263 inch, or above a quarter of an inch. To reduce these readings to the sea level, it is requisite to add 0·183 inch, when the temperature is as low as 57·6° as in 1848, and 0·182 when the temperature is as high as 65·3° as in 1846; thus the mean pressure reduced to sea level for the last fourteen years is 29·994 inches.

The mean amount of cloud of the last fourteen years is 6·4, ranging between 4·9 in 1847 (or about half the sky covered with cloud), and 7·3 in 1849 (or nearly three-fourths of the sky clouded).

The mean number of rainy days in the last fourteen years is 16, ranging between 10 in 1847, 1853, and 1857, and 25 in 1848, a difference of 15 days. The years of but little rain are 1847, 1853, and 1857, and of much rain, 1848, 1849, and 1852.

E. J. LOWE.

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ASTRONOMICAL OBSERVATIONS FOR AUGUST, 1860.

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THE Sun is in Leo till the 22nd, and then in Virgo. He rises in London on the 1st at 4h. 25m., on the 10th at 4h. 39m., on the 20th at 4h. 55m., and on the 30th at 5h. 11m., setting in London on the 1st at 7h. 46m., on the 10th at 7h. 30m., on the 20th at 7h. 10m., and on the 30th at 6h. 49m. He rises in Dublin on the 1st seven minutes earlier, and sets six minutes later than in London, and on the 20th rises six minutes earlier, and sets five minutes later than in London. He rises at Edinburgh on the 1st seventeen minutes earlier, on the 20th twelve minutes earlier, and on the 30th eight minutes earlier than in London, and sets on the 1st seventeen minutes later, on the 20th eleven minutes later, and on the 30th seven minutes later than in London. On the 1st there is in London 15h. 21m. sunshine, in Dublin 15h. 34m., and in Edinburgh 15h. 55m.; and on the last day 13h. 38m. in London, and 13h. 53m. at Edinburgh.

The Sun reaches the meridian on the 1st at 12h. 6m. 1s.; on the 15th at 12h. 4m. 11s.; and on the 31st at 12h. 0m. 3s.

The Equation of Time on the 1st is 6m. 1s., on the 15th 4m. 11s., and on the 31st 0m. 3s. before the Sun (addative).

Day breaks on the 1st at 1h. 30m. a.m., on the 8th at 1h. 58m., on the 20th at 2h. 36m. and on the 30th at 3h. 2m.

Twilight ends on the 2nd at 10h. 34m., on the 13th at 9h. 51m., on the 21st at 9h. 25m., and on the 31st at 8h. 55m.

Length of day on the 7th, 15h.; and on the 20th, 14h. 15m.

The Moon is full on the 1st at 5h. 33m. p.m., and again full on the 31st at 8h. 57m. a.m.

New Moon on the 16th at 10h. 19m. p.m.

There is an eclipse of the Moon on the 1st of August, but *invisible* at Greenwich. It will be visible in Asia, Africa, and Australia.

The Moon is at her least distance from the earth on the 17th, and at her greatest distance on the 5th.

Mercury is situated in the constellation of Leo, and favourably situated for observation in the mornings. He is stationary on the 19th, and reaches his greatest western elongation on the 27th. He rises on the 4th at 5h. 45m. a.m., on the 14th at 4h. 21m. a.m., and on the 29th at 3h. 24m. a.m., setting on the 4th at 7h. 33m. p.m., on the 14th at 6h. 41m. p.m., and on the 29th at 6h. 19m. p.m.

Venus is situated in Gemini at the beginning, and in Cancer at the end, of the month. She is stationary on the 9th. Venus attains her greatest brilliancy on the 23rd. She is favourably situated for observation in the morning, being the most brilliant object in the heavens. Her shape is that of a slender crescent, and her size will reach 57″ in diameter. Venus rises on the 4th at 3h. 0m. a.m., on the 14th at 2h. 17m., and on the 29th at 1h. 42m. a.m., setting on the 4th at

5h. 50m. p.m., on the 19th at 4h. 59m. p.m., and on the 29th at 4h. 42m. p.m.

Mars is situated in Sagittarius, and, although near the horizon, is a conspicuous planet. He is an evening star, and is stationary on the 18th. He rises on the 4th at 7h. 22m. p.m., on the 14th at 6h. 36m. p.m., and on the 29th at 5h. 33m. p.m., setting on the 4th at 2h. 0m. a.m., on the 14th at 1h. 16m. a.m., and on the 29th at 12h. 26m. a.m.

Jupiter is in the constellation Cancer, and is a morning star. He rises on the 4th at 4h. 3m. a.m., on the 14th at 3h. 36m. a.m., and on the 29th at 2h. 56m. a.m., setting on the 4th at 7h. 34m. p.m., on the 14th at 7h. 0m. p.m., and on the 29th at 6h. 8m. p.m.

Saturn is in Leo, and unfavourably situated for observation, being in conjunction with the Sun on the 22nd. He rises on the 4th at 5h. 52m. a.m., on the 14th at 5h. 19m., and on the 29th at 4h. 30m. a.m., setting on the 4th at 8h. 22m. p.m., on the 14th at 7h. 45m. p.m., and on the 29th at 6h. 51m. p.m.

Uranus is in Taurus, and is visible at a late hour, rising on the 4th at 11h. 36m. p.m., on the 14th at 10h. 58m. p.m., and on the 29th at 10h. 0m. p.m.; setting on the 4th at 3h. 54m. p.m., on the 14th at 3h. 16m. p.m., and on the 29th at 2h. 18m. p.m.

The eclipses of Jupiter's satellites are invisible during the month.

There are no occultations of stars by the Moon larger than of the 6th magnitude.

Duration of twilight after sunset on the 1st, 2h. 56m.; and on the 21st, 2h. 20m.

The variable star Algol attains its least light in the evening, on the 10th, at 11h. 19m.

Stars on the Meridian.—On the 13th, γ Aquilæ, at 10h. 0m. 26s. p.m.; on the 15th, β Aquilæ, at 10h. 10m. 23s. p.m.; on the 16th, α Lyræ, at 8h. 50m. 24s. p.m.; on the 18th, β Lyræ, at 8h. 55m. 13s. p.m.; on the 20th, γ Draconis, at 7h. 55m. 56s. p.m.; on the 22nd, α Lyræ, at 8h. 26m. 49s. p.m.; on the 23rd, α Cygni, at 10h. 27m. p.m.; on the 25th, α Herculis, at 6h. 51m. 19s. p.m.

Meteors or falling-stars are abundant in August. and more especially at the epoch of the 9th and 10th.

E. J. Lowe.

THE MICROSCOPIC OBSERVER—AUGUST.

Fungi.—The minute parasitic fungi are now abundant, and will supply an endless variety of subjects. These plants are destitute of chlorophyll; their reproductive organs are microscopic, and consist of two kinds, *mycelium*, of which the spawn of the common mushroom is a well-known example, and *sporules*, which bear some affinity to the fructification of ferns. There is an intermediate mode, common among the simplest ferns, where a modification of cells takes place at the end of a filament, which rises up from the general body of the mycelium. The minute fungi are known as moulds and mildews, and in this present damp season they have been produced abundantly on the leaves, and stems, and fruits of plants, and are always common on organic subjects in a state of decay. To preserve these for observation, place the leaves and branches as collected in a box half-filled with damp moss, and covered with a square of glass. The highest forms of fungi afford the most easily-traced examples of the development of spores upon a hymenium. All our common fungi are fruits, bearing spores in the cells with which the gills are clothed. The puff-balls and agarics afford interesting examples of free spores. In submitting specimens of moulds and mildews to the microscope, they may be referred to their places in the six recognized orders (Berkeley) as follows:—Those with filamentous mycelium, bearing sessile fructification, consisting often of septate spores, may be referred to *Uroideæ*, or smuts; those with filamentous epiphytic mycelium, producing erect filaments, bearing terminal, free, single, simple, or septate spores, may be referred to *Botrytoideæ*, or mildews; those with filamentous mycelium, bearing stalked sacs, containing numerous spores, belong to the class *Mucoroideæ*, or moulds. The following microscopic fungi are plentiful now:—*Æcidium menthæ*, on the mint; *Æ. berberidis*, on the common barberry; *Æ. urticæ*, on the nettle. In the woods, specimens of Hydna, Hexagonia, and other fungi which infest the roots of trees. These should be collected to furnish sections, for the exemplification of their cell-structures and the disposition of the sporules.

Ferns.—The fructification of the majority of British ferns is now in a mature state, and the fronds may be collected for the purpose of comparing the various modes in which the sori are disposed. *Osmunda regalis* is an example of fructification on metamorphosed pinnules. The sporanges have at the back a broad imperfect annulus. The naked circular sori of *Polypodium vulgare* may be regarded as the type of the section which it represents. The sori of the common Lastrea are covered with a reniform indusium. In *Polystichium* the indusium is circular, and attached by its centre; this genus takes its name from the regular lines in which the sori are disposed. In *Cystopteris* the sori are roundish, and the indusium is either hooded or cucullate, fixed by its base beneath the sori, which it covers when young. The stems of ferns show a peculiar arrangement of the fibro-vascular bundles, and the best examples of the elementary tissue known as scalariform ducts. The scales on the rhizomes and leaf-stalks are good objects, especially for the character of their cells. *Hymenophyllum* has no stomata, *Pteris* has them, and the leaves of the brake should be selected for the purpose of exemplifying them. Sections of the leaves of ferns, shaved off horizontally from the surface, show the epidermal cells with exquisitely zigzagged walls. The *thecæ* should be studied with special reference to the classification, the points to be noted are the nature of the annulus, the character of the spores contained within them, and the resemblance of these spores to pollen grains.

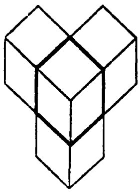
Cells and Stomates.—Thin sections of fruits readily supply, at this season, examples of cellular physiology. The common rush gives examples of stellate cells, the pith of elder gives irregular hexagons. Slices of apple show cells containing a nucleus; the hard shell of a plum or cherry-stone will furnish pretty subjects for the study of cells if thin slices are taken by means of a razor. Stomata are the passages of communication from the intercellular passages through the epidermis to the air. Succulent leaves offer examples of the largest stomata, hard leathery leaves the smallest. The leaves of the holly, laurestinus, and vine are good subjects for the observation of the stomata on the under surface. The sempervivum has them on both sides, and most numerously on the upper.

Seaside Observations.—The physiological structure of Algæ, the parasitic growths on their fronds, the foraminifera which may be washed out from tufts of Laminaria, and the many forms of Diatomacea and Confervacea, offer an endless variety of subjects. The Algæ are an important class of Thallophytes which, under the microscope, withhold but few of the secrets of their history. The Ceramidia exemplify the Rhodosperms, having spores in external masses inclosed in conceptacles. The common Fucus is a Melanosperm, which produces conceptacles containing sporanges and antheridia, the spores being fertilized by Spermatozoids after the discharge of both from the parent. The microscopic Algæ present themselves in innumerable forms in all shore gatherings. In these the fructification is varied in its details, but may be reduced to three general heads:—1. Spores produced by conjugation; 2. Spermatozoids produced from the contents of cells; 3. Zoospores.

Objects worth Seeking.—*Tegenaria domestica*, the common house-spider; the spinneret and spinning tubes were described at page 217 of our first volume. *Hydrachna globula*, a pretty red mite, common now in brooks. Note the ensiform mandibles, the joints of the palpi, the terminating claws. *Palmella cruenta*, the red stain on the surface of neglected damp walks, and along the margins of ditches, is very plentiful this season. Its simple cellular structure shows its low position; it is a near relative of the red snow-plant. Treated with sulphuric acid and iodine, the cells show the cellulose coat and granular contents. The hairs around the stamens of the spiderwort, *Tradescantia virginica*, the leaf of *Valisneria spiralis*, leaf of *Anacharis alsinastrum*, leaf of *Hydrocharis*, leaf of *Chara vulgaris* are in good condition now to show the circulation of the sap. Longitudinal slices should be taken, and in the case of *Chara* the external calcareous coating must be removed. Fruits will furnish examples of cell-structure; the testa of many seeds make good opaque objects for observation with a low power, their markings in many cases resembling the elytra of beetles. Those now accessible and particularly interesting are Lychnis, Mignonette, Nigella, Anagallis, Bird's-foot trefoil, Datura, Sedum, Delphinium, Foxglove, Antirrhinum, Catchfly, Dianthus Poppy.

Mr. Noteworthy's Corner.

Do Bees make Hexagonal Cells?—Messrs. Darwin and Tegetmeier, I perceive, have been saying rather disparaging things of some old friends of mine, the bees. In endeavouring to show that the form of a transverse section of the cell results merely from pressure, and not from a mathematical instinct, they overlook the two following curious facts, which must be otherwise accounted for:—First, that the cells on the opposite sides of the comb are so placed that the *axis* of one is continuous with the intersection of the sides of the other, an arrangement by no means a matter of necessity: thus, if in the figure the thick line represent the transverse section of a cell on one side, then the hair lines will represent the arrangement of the cells on the other. Secondly, that the terminating surface of each cell is not a plane, but consists of three planes forming a solid angle, and that solid angle such as to give a maximum solid content with a minimum of surface. The following compendious history of the question is given in "Gregory's Examples of the Differential and Integral Calculus:"—"Maraldi was the first who measured the faces of the terminating solid angle, and he found them to be 109° 28′, and 70° 32″ respectively. It occurred to Reaumur that this might be the form which, for the same solid content, gives the minimum of surface, and he requested Kœnig to examine the question mathematically. That geometer confirmed the conjecture, the result of his calculations agreeing with Maraldi's measurements within 2′. Maclaurin and L'Huillier by different methods verified the preceding result, excepting that they showed that the difference of 2′ was due to an error in the calculations of Kœnig, not to a mistake on the part of the bees." Now I think, Mr. Noteworthy, we shall be justified in attributing to bees a mathematical instinct, until these facts are accounted for on some other hypothesis equally satisfactory, which the "pressure" hypothesis certainly is not.—R. Bithell.



Rainfall on an Acre of Ground.—Mr. Noteworthy has been favoured by Colonel Austen, of the Pavilion, Aldwick, with the following.—"A pint of water weighs 1¼lb., and measures cubically 34·75 inches, and as an acre contains superficially 6,272,640 square inches, each Sussex acre received last year 3111 *tons* of rain on an average, as that was the amount of our local rainfall, and the 35th of this, representing *one inch* of rain, is equivalent to 90 *tons* per imperial acre, or 22,680 imperial gallons of rainfall, and, consequently, every cottager's rood (of kail-ground) receives 90 hogsheads of water whenever one inch of rain falls thereon."

The Eclipse was favourably observed throughout Great Britain and Europe generally, and some excellent photographs of it were taken.

1, Dotted Border; 2, Erannis aurantiaria; 3, Common Vapourer; 4, Small Brindled Beauty; 5, Pale Brindled Beauty; 6, Fumea nitidella.

WINGLESS MOTHS.

THERE is no department of animal life which exhibits so many singular, and what at first sight appear irregular, aspects as that comprising the world of insects; and the metamorphoses through the medium of which every insect passes on its road to maturity is perhaps the greatest of the wonders which this form of animal life exhibits. But these singular changes of appearance are again subject to aberrations which are equally wonderful. It is not, however, to the curious stages of insect transformations that I am now about to call attention so much as to the strikingly different aspects sometimes presented by the opposite sexes, especially in some of our native moths.

The female moths of several species (some of which belong to genera very widely separated by their general character) exhibit a strange aberration from the usual forms, in consequence of being entirely apterous, or without wings. This peculiarity of structure in the female is marked by several gradations in its departure from the usual conformation. In some species the wings of the female only differ from those of the male in being much shorter, while they are still capable of serving for the purpose of flight. The next link is that in which the wings of the female are so much reduced in strength and size as to render them almost useless, except for a kind of fluttering assistance which they give to the ordinary motion of the legs and feet. It is not my purpose here to cite examples, or dwell upon the description of these intermediate structures, which hold a position midway between the winged and the wingless of female moths.

The first example which I shall describe in detail is one in which the wings, though not absent, are yet so absolutely rudimental as to be entirely useless for the purpose of flight. This species, the female of which is represented in the accompanying woodcut at No. 1, is *Erannis progemmaria* (the Dotted Border). This species belongs to the third subdivision of moths, termed *Semidiurnæ*, as partly flying by day as well as night, and to the first family of that division termed *Geometridæ*—a name which some of our readers may not know is derived from the peculiar action of the caterpillar. Being without legs

In the centre of the body these larvæ draw up the two hinder pair of legs close to those near the head, thus forcing the body into a loop, the front portion of which is then stretched to its full length, while the hind-legs remain fixed. The looping is then repeated. It has been thought to have the effect of *measuring*, from which these larvæ have been termed "earth measurers," or *Geometridæ*. There is nothing in the aspect of the caterpillar of the species under description to denote that a certain portion of them would become elegant winged moths, while another portion, exactly similar in outward appearance, are destined in their future form to be the strange-looking and anomalous wingless creatures, which are the females of this species. The male is a slight and elegantly-formed moth, the body being, as in all the *Geometridæ*, extremely slender in proportion to the amplitude of the wings, which are of a delicate buff colour, variegated with transverse bands of a deeper tone of the same colour. The female, on the contrary, has the body short and thick, and the little rudimental wings, which are miniature copies in colour and marking of those of the male, are so small as to render their character extremely doubtful to a careless observer, who would never guess, in fact, that the insect was a moth at all, much less the female of a kind which has a pair of wings which measure in their fullest expanse full an inch and a-half across. If carefully sought with a light at night, this curious-looking creature may be found on hedges in the months of January or February, winter being the season of the appearance of this interesting species, on which account it has been placed (with others of a similar character appearing at the same time) in a sub-family termed the *Hibernidi*.

As the second illustration of the different [illegible] wingless moths, I have taken another [illegible] the same genus. The female of *[illegible]urantiaria*, represented at No. 2, has the wings still more rudimental in character than those of its relative, *H. progemmaria*. The caterpillars of this species feed on the foliage of oak and birch; and neither in that state nor in the subsequent chrysalis stage is there anything to indicate that a certain portion of the complete insects about to be produced will be nearly without those delicately-framed and beautifully-marked wings, which are almost invariably the great distinctive character of both sexes of the extensive order which comprises the various families of butterflies and moths. The perfect insects emerge from the chrysalis at the end of October or beginning of November, winter being the season of appearance of this as well as of the last-described species.

The third example (No. 3) exhibits a female moth, in which the rudimental wings are scarcely perceptible; the general appearance of the creature being still more unlike that of a moth than either of the others, in consequence of the greatly enlarged body, which, covered with a thick silky fur, and entirely destitute of wings, presents an aspect so singular that few would imagine it to be a moth. This creature is the female of the well-known Vapourer moth, *Orgya gonostigma*. The male insect is a small-bodied, broad-winged moth, of a rich deep brown colour, the fore-wings being beautifully varied with small and delicate markings of orange, white, and lilac. The wingless female is of a much paler and cooler toned brown, except towards the head, where it assumes a rather bright foxy tone. This species is rather rare, being only found in our southern counties. The caterpillar is brown, with crimson stripes and other marks at the sides. It has on the back four broad and solid square-topped tufts of silky hair, and at the head, are two spreading brushes of black hair, each tipped with a minute club or knob, while the segment next the tail is furnished with another similar tuft. It feeds on the foliage of various kinds of trees in the spring and summer, and the perfect moths, male and female, appear in the autumn. There is only one other species of the genus *Orgya*, which is the common Vapourer (*Orgya antiqua*), differing from the former species in several particulars. The female is, however, equally wingless, but much smaller, and of a dull ashy-gray colour, while the body, as well as the broad wings, of the male are of rich full brown, varied by a small white spot in the centre of each of the fore-wings. This species is common in large towns, especially in London, where the somewhat singular character of its flight, rising and falling in fitful snatches, suggested to some of our early entomologists the name of the Vapourer, by which both species are still popularly known. The caterpillar, which is found abundantly upon the foliage of rose-trees and other shrubs, very much resembles that of the last-described species; but its square silky tufts on the back are paler, and the stripes at the sides are pale brown instead of crimson; there are, however, some crimson marks, which make this common larva very remarkable. Duponchel states that the caterpillars destined to become females are much paler, being varied with gray and pale yellow. Any one curious to see a living specimen of one of the wingless moths described in this paper, may easily gratify their curiosity by collecting a few dozens of the caterpillars just described, which they will easily recognize by the curious spreading pencils of knobbed hairs projecting forward and outward beyond the head. These must be placed in a box, covered with a wire gauze, in some open situation, protected from the direct rays of the sun, and from rain, by a sloping board, or some other similar contrivance. Fresh food must be supplied to them daily from trees of the same kind as those on which they were found. In due time these larvæ will pass into the chrysalis stage, and in about twenty-one days the perfectly-formed moth will burst the shell of the chrysalis; and among such a number a few females are pretty sure to appear.

The fourth illustration, in the engraving above, is that of the female of *Nyssia zonaria*, the specific name of which refers to the alternate black and yellow zones with which the bodies of both the males and females are marked; and hence also the popular name, the small Brindled Beauty. Though the *Nyssia zonaria* is rare and extremely local, it so happened the first apterous moth I ever saw was a female of this species. I was then quite a tyro in entomology, and being present at one of the late Mr. Francis Stephens's Wednesday evening entomological meetings, about the year 1845, a box containing a number of the larvæ of *Nyssia zonaria* was exhibited as an interesting novelty, the species being then still interesting as having only been added to the English catalogue a few years previously. Slender and gracefully-formed caterpillars, of a dark gray-olive colour, with a bright yellow stripe on each side, were feeding upon some fresh leaves of the common milfoil, their natural food; and though the box did not appear to be of sufficient depth to allow them to descend into a layer of earth to undergo their change to the chrysalis state, in an analogous manner to that in which the transformation takes place in their natural state, yet Mr. Stephens succeeded in obtaining from them many fine specimens of the perfect insect, several of which were the interesting wingless females. This species became first known as British on the banks of the Mersey, especially near Black Rock, which was then considered the only locality which it frequented. Towards the close of the autumn the caterpillar buries itself about three or four inches deep in the sand to change to the chrysalis state, and the perfect moth appears in the following months of February and March, a second brood appearing in July.

No. 5 in the accompanying wood engraving represents the wingless female of

Phigalia pilosaria (the pale Brindled Beauty). We have seen that in the case of *Orgya gonostigma*, the body of the female moth was much more bulky than that of the male; but as an example of the fact that there appears to be no easily defined rule for these relative proportions, the female moth is in this instance quite diminutive in proportion to the male, even in the body itself, without reference to the wings. The male moth measures nearly two inches across the expanded wings, and the body is nearly an inch in length; while the female is only of the size shown in the engraving, in which all the specimens are represented of their natural size. The caterpillar of this species feeds on oak and whitethorn late in the summer, passing the winter in the chrysalis state, and the perfect moth appearing in the spring.

The last example (No. 6) represents the extreme aberration of the apterous females of the moth family, from the ordinary winged type. The creature represented is a female belonging to a family of small moths, known as the *Psychidæ*. In the section of the family to which this species belongs, the females are not only wingless, but also without legs and without antennæ, being simply vermiform or maggot-shaped. These singular female moths are said to produce fertile eggs for many generations without impregnation, and hold altogether a most anomalous position among lepidopterous insects, though the males present nothing remarkable in their general aspect. The maggot-formed female is represented outside one of the caterpillar cases, in the interior of which the chrysalis was formed, and from which the "perfect" moth has just emerged, and will not be able to travel further, but will deposit its eggs on the outside of the case. The cases formed by the caterpillars of this class of moths are in themselves very curious, being formed of small particles of earth, bark, and other suitable materials, glued together by a liquid which the larvæ have the power of exuding for that purpose. These caterpillars are termed sack-trägers by German entomologists. They feed with the head and three pairs of pectoral legs protruded from the case, and the caterpillar no doubt retreats within it, on the approach of those enemies which its instincts teach it to avoid. There are many other singular circumstances connected with the history of wingless moths, but the present article has already reached its utmost limit. H. Noel Humphreys.

COLLECTING SEA-SHELLS.

In the natural course of things the young conchologist who has done all he can with land and fresh-water shells, will turn his attention to the British marine species, which open a wider field of research and afford more exciting sport.

A short excursion down the Thames valley, easily effected by the aid of railway or steamboat, will conduct to waters influenced by the tide. In the ditches and puddles along the Thames bank, from East Greenwich to Gravesend, are to be found *Conovulus denticulatus*, *Assiminea Grayana*, and three species of *Rissoa* (viz., *anatina*, *ventrosa*, and *ulva*), together with true fresh-water shells, altered in their appearance, for the worse, by contact with brackish water. In the ditches at Tilbury Fort there is a small variety of the cockle (*Cardium edule*), which, on the contrary, has suffered from the influence of the fresh-water. Other shells flourish best in brackish water, like the *Scrobicularia* *piperata*, which, though a common shell in ditches near the sea, is rarely obtained in a fresh state on account of the difficulty of approaching its chosen habitat. In the deep silt by the riverside of Gravesend, the *Mya arenaria* attains a large size, and colonies of it occur, along with *Tapes decussata*, in the beach at Southend, where, at low water, they may be dug out with a spade from a bed of stones and hideous black mud.

On the eastern coast there are many long reaches of barren sand, and the visitor who goes to Yarmouth, Lowestoft, and other watering-places, will obtain change of air and a good beach, but he will meet with no shells among "the shining pebbles and the sand;" whereas at Hunstanton and Cromer, and wherever there are rocks, or a clay beach firm enough for shell-fish to burrow in, there they will be found. By looking at the Ordnance map, it will be seen there are some sheltered nooks along the coast marked "Shell-ness," and in which, no doubt, the sea heaps up multitudes of shells. One of the most remarkable of these is the Shell-ness near Sandwich—a favourite place of resort for visitors from Ramsgate. The beach is here entirely formed of an inexhaustible mass of shells, among which are myriads of the little cowry (*Cypræa Europea*), silver *Trochi* of several species, *Natica monilifera* and *alderi*, *Scalaria communis* and *clathratula*, the key-hole limpet (*Fissurella*), and *Emarginula reticulata*, several species of *Tellina*, *Pecten varius*, and *P. pusio*, *Syndosmya alba*, *Nucula nucleus* and *Leda caudata*. Many of these shells may have lived in the adjoining bay, but the greater number must have travelled long distances since their owners died; some, like *Fusus gracilis* (commonly called *islandicus*), from the coast of Northumberland, and some from the south-west, like the "Torbay bonnet-limpet," have been brought together at this spot by the meeting of the tides; for it appears that the tidal wave takes as long to get up the Channel and round the South Foreland, as it does to travel from the Land's End to the Orkneys and return down the German Ocean to the Goodwin Sands. Hence arises that graveyard of good ships, and hence that "Shell-ness" of Pegwell Bay. The locality appears to have been even richer formerly than it is now; for, in 1784, Mr. Boys, of Sandwich, had obtained eighty-seven species of minute shells, many of which, however, were *Foraminifera* and not *Mollusca*, and about these he published (in conjunction with Mr. Walker) a quarto book entitled, "Testacea minuta Rariora." As these minute shells cannot be selected on the spot, it may be worth while to bring home a sample of the most promising-looking sand to examine at leisure. There is another repertory close by; the drawer in which chemists keep sponges for sale will usually afford a small quantity of sand containing minute shells, which come from the Mediterranean or Antilles, and are charming objects for the microscope. The sand must be sifted through muslin, or, better, through a perforated metal sieve, and in sorting it a small quantity at a time should be spread on black paper, and examined with a magnifying lens, which may be an ordinary pocket lens, with a hole cut in the case to fit on a small brass stand (Fig. 1).*

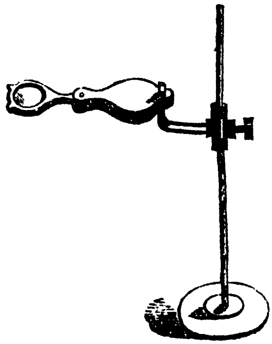


FIG. 1.

But we are impatient to get upon a sea-beach where we may find something alive. Suppose we try Folkestone, because there we

* Messrs. Field, of Birmingham, make a stand, furnished with a rack and three moveable powers, for dissecting, etc., at the price of 15s.

have a hospitable friend, who will give us good guidance and entertainment. The tide is going out, and there is a wide tract of rocks already bare. Over these we scramble, thankful to the myriads of little barnacles which roughen the surface, and surely were created to prevent our feet from sliding. We reach the margin of the brine at last, and see! there are the limpets on the rock, each with his little flag of green weed on the summit of his tent, and with them are the small dog-whelks (*Purpura lapillus*), seeking for mussels; and

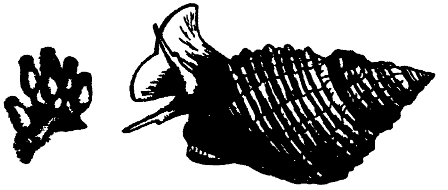


FIG. 2.—Dog whelk (*Purpura lapillus*) and a small cluster of its ovi-capsules.

there are the small gray *Trochi* and yellow nerite-shaped periwinkles on the sea-weed, creeping about and brandishing their tentacles as they go. Just now, when the waves were heaving this tangled forest of weeds, and dashing the pebbles amongst the rocks, the shell-fish stuck close enough, and never showed their horns; but as soon as the rocks are uncovered they begin to move—those at least which are young and have healthy, growing appetites—and make the best use of their time. You spring from the rock to a small level space of hardened, sandy mud, and are immediately saluted with a discharge of water, as from a dozen squirts; you have disturbed a colony of the "piddocks" (*Pholas dactylus*), and they have revealed, in their alarm, the secret of their hiding-place. With a chisel, or small spade, you dig them out, and having washed one in the nearest pool, admire the thin white shell with its rasp-like fringes of small sharp spines; admire also the ice-like translucency of the creature itself, which looks as if one might eat it, and very good it is, for *bait*. Presently you will find another kind of *Pholas* (*P. candida*), smaller and more delicate than the first; and you may meet with loose pieces of rock thrown up by the sea, honey-combed by another boring bivalve, the *Saxicava*. We had observed that each piddock lived in his own separate cell, sunk vertically in the beach, and respectful of the comfort of his neighbours; but the *Saxicavæ* attack a stone on every accessible side, and penetrate in any direction, breaking into each others burrows, and finally destroying their own little republican stronghold.

Following the sea as it retreats, and searching the small weed-fringed pools that

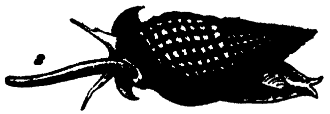


FIG 3.—Dog whelk (*Nassa reticulata*). Animal with foot cleft behind.

are left, we shall find the sea-hare (*Aplysia*), or "cow," as some say, because it has both horns and ears; instead of going to sleep in a shell, this creature keeps its shell within itself, folded up in its mantle.

By turning over the loose stones we may also meet with the sea-lemon (*Doris*), which at first we mistake for a bit of orange-peel, but find that it is alive, and clings very tightly to the rock; this creature has no shell, but if we take it home and place it in a bucket of sea-water, it will exhibit a circle of the most elegant feathery organs, which are its gills. That mass of the great tangle, torn from the rocks beyond low-water mark, is worth examining; on its broad frond there may be a colony of small horn-coloured limpets, with narrow rays of brilliant azure (the *Patella pellucida*), and amongst its labyrinthic roots other limpets are wont to abide, destitute of blue rays and so much more solid that you will think, with Pennant, they are another *species*, until, having seen a great many examples of all ages, sizes, and colours, you find it is only a *variety*, and that the difference in its appearance is caused by difference of food, concealment from light, and other circumstances. Fish up that piece of rock from under water; upon it there is a small multivalve shell, like a "wood-louse," called the *Chiton;* it sticks like a limpet, but having eight valves instead of one, it rolls itself up when you have detached it, and you cannot open or flatten it by force, without injury. You must take it home, and when placed in a basin of sea-water it will soon fix itself to the smooth interior. It is then easy to slide it to the edge, and transfer it quickly to a flat stick or lath, and tie it down skilfully with thread. A number of them may be put on the same stick, and killed by immersion in hot water, and then dried in the shade. With the larger foreign *Chitons,* it is necessary to remove the animal, when dead, from its shell, and again tie the latter on a stick till dry.

FIG. 8.—*Chiton piceus,* West Indies. Side view of a specimen partly rolled up.

We shall find enough amusement amongst these rocks for many days of our summer vacation; to learn all about them we need live there all the year round; but, by way of variety, we will move on to a very different spot, at no great distance, the flat sandy shore, wild bleak and inhospitable, of Dungeness.

"How is the tide?" Mr. Mackie is still our guide, and we should have asked before. It is the first question with the conchologist on arriving at the seaside. We need not remind our readers at home that there is "high-water at London Bridge" twice in every twenty-four hours; but when they are by the sea, it will be very desirable to impress them with the fact, and also that it happens nearly half an hour later each tide. Moreover, on some very shelving coasts, like this of Dungeness, the sea takes seven hours to go out, and only five hours coming in, making us wait longer, and giving us less time to explore when low-water has at length arrived. Twice a month, after new and full moon, there is a "spring-tide," when the sea goes out further than usual; and the spring-tides of the Vernal and Autumnal Equinoxes are lower than any other tides, so that twice in a year the resident by the sea may explore a wider tract of sea-bed and become acquainted with animals whose haunts are never else exposed. Whilst we are talking the sea has gone out a little way, but there is no sign of life save the castings of worms upon the sand; and yet there ought to be something, for those flights of gulls, which retire as we advance, were surely feeding, and along the

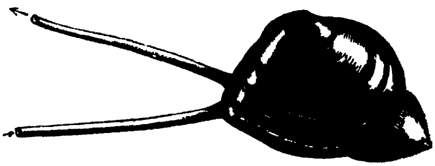


FIG 4.—*Tellina solidula.*

high-water line we noticed a considerable sprinkling of dead shells and *Sertulariæ.* The bivalves were mostly odd valves, with a round hole in many of them, bored by the

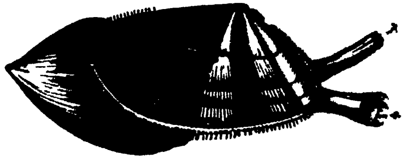


FIG 5.—*Donax anatinus,* with the foot protruded; the arrows show the exhalent and inhalent siphons.

whelk or *Natica.* These univalves have buried themselves out of harm's way, and indeed they have to burrow for most of their meals. Wherever you see a dimple in the sand, there, by digging, you will find a living bivalve. There are great beds of cockles and colonies of *Tellina tenuis*, and *T. solidula*, and *Donax anatinus;* and further out there is the great prickly cockle (*Cardium echinatum*), and the *Mactra*, which fisher's wives call "the hen;" and there are razor-fishes (*Solen siliqua* and *ensis*), which burrow so fast that you will not overtake them with your hands; but if you are provided with a stiff wire bent into a pointed hook at the end, you may plunge it quickly into their burrows and pull them out.

It has been noticed that even between high and low-water marks there is a difference in the shell-fish at various levels. On rocky coasts there is one kind of periwinkle and a minute bivalve, which prefer the very line of high-water, where they are only wetted twice a day. The mussel, and edible periwinkle, and limpet, prefer a lower zone and a rather longer immersion, and a richer repast; while a third group of shell-fish is only found near low-water. Beyond this the bed of the sea is marked out into regions, like the zones of vegetation on a mountain-side. Sea-weeds flourish between low-water mark and fifteen fathoms, forming miniature forests in which the vegetable-feeding shell-fish abound; beyond, they make room for the animal weeds or horny zoophytes (*Sertularia*), in which carnivorous shells predominate. From 50 fathoms to 100 or even 300 fathoms, there are a few small deep-sea corals, and a vegetable incrustation called the *Nullipore*, and living shells become scarce. The profound depths of the ocean have afforded only one family of microscopic plants (*Diatomaceæ*), and one class of minute animal shells, the *Foraminifera* and *Polycystinea*, and these may have been drifted out from great distances, and have sunk down finally into the abyss. The following table will show some of the shells found in each of these regions, or the zone in which some of the shells are most abundant:—

REGIONS OF DEPTH OF THE BRITISH SEAS.

1. LITTORAL ZONE. The tract between tide-marks.	Litorina rudis; Kellia rubra. Mytilus edulis; Patella vulgata. Litorina litorea; Purpura lapillus. Cardium edule; Tellina solidula. Mya arenaria; Solen siliqua. Litorina neritoides; Trochus cinerarius.
2. LAMINARIAN ZONE. Tract between low-water mark and 15 fathoms.	Tapes pullastra; Modiola; Chiton. Patella pellucida; Lacuna; Rissoa. Oyster-beds; Nucula nucleus. Trochus zizyphinus, magus. Corbula nucleus; Natica nitida.
3. REGION OF CORALLINES. 15 to 50 fathoms.	Fusus antiquus; Buccinum undatum. Pullastra virginea; Artemis exoleta. Scallop-banks (Pecten maximus and opercularis); Pileopsis Hungaricus.
4. REGION OF DEEP-SEA CORALS. 50 fathoms to beyond 100.	Dentalium; Mangelia; Rissoa. Neæra; Terebratula; Crania. Fusus Norvegicus; Aporrhais pes-carbonis.

Since the majority of sea-shells live beyond low-water mark, they can only be got at in a fresh state by means of the dredge. If unprovided with apparatus of his own, let the collector go out with the fishermen, by whom a small gratuity will assuredly be deserved for their customary civility. In Pegwell Bay, Ramsgate, we have long ago enjoyed a day with the whelk-dredgers, who fished with a decked boat, and manufactured a welcome cup of hot coffee for themselves and visitor. They sail out to the chosen spot, then take in the sail, let go the dredges and drift as far as they desire. When the dredges are hauled up and emptied, they again make sail, and, if the ground be good, return nearly to the starting-point, and again drift and dredge, thus working over the sea-bed almost as regularly as the ploughmen circle in a field. Of course you must look sharp and pick out what you want directly, for as soon as the dredgers have secured their

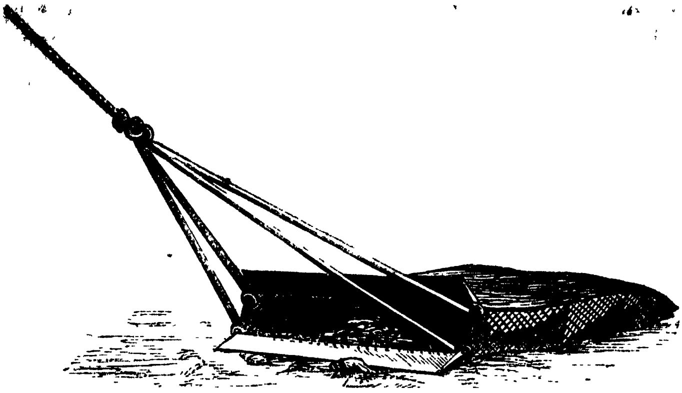


FIG. 6 —Dredge in Action.

whelks or oysters, they are anxious to clear the deck by throwing the "rubbish" overboard. These whelk-dredges are made of hide, with small slits to let out the water and sand; but the ordinary oyster-dredges are made of iron rings, and are very rough and clumsy, smashing most of the larger things and allowing the smaller to escape. Therefore it is better to have a dredge of one's own, made of wrought iron, with a bag of raw hide (Fig. 6). The ironwork can be made by any blacksmith. The hide can be bought at some tobacconist's, and will wear best if made in two pieces, each with the hair outwards and turned in the direction it will be drawn over the ground. The sides should be made of netting, to allow the water to escape, and it may be fastened to the iron with copper-wire. The dredge should be strongly made, but neither too large nor too heavy for a person to carry conveniently in his hand. Two feet, or even less, will be length sufficient, and the opening should not be more than four inches wide, so as to admit only stones of moderate size. A good rough piece of rock, full of holes and crannies, is indeed a prize, when got up from deep water. Arks, *Terebratulæ*, and many other things are found in such situations; but there is some danger of making a hole in the bottom of the dredge or losing it altogether. It is usual to fasten the rope to only one ring of the dredge, tying the other to it with spun-yarn, which will break if the instrument gets foul of a rock, and by releasing one end allow it to be drawn up into the boat.

The contents of the dredge should be emptied into a sieve and washed in the sea. It is best to have two sieves, made of copper wire; one, with large meshes, fitting into the other, which should be much finer. A jar of *sea-water should be ready to receive anything* which it may be desirable to take home and examine alive, and a jar of *methylated* spirit for anything you wish to preserve for future examination. Stone jars are made for this purpose, with metal clamps to hold the lids on.

Hiring a decked sailing-boat for private dredging is rather expensive, but the conchologist who is up to rowing, and understands the management of a boat, may, with the help of a friend, do a good day's work at a small cost. Hastings, Worthing, Weymouth, the coast of Devon, and the Channel Isles, afford great variety of shells in shallow water. But in the north the best work is done in the deepest zone.

There are some shells which even the dredge will not obtain. Those which burrow deeply are only obtained by rare chance, such as getting entangled by the hooks of a deep-sea fishing-line. The dredge brings up the siphons only of *Panopæa*, *Solen*, *Solecurtus*, etc., cut off from the shell, and writhing like worms. The inhabitants of very rough and rocky bottoms are also safe against almost any attempts, and these include not only the *Terebratulæ* and other rarities of the deep sea, but also a large proportion of the most conspicuous univalves in the Laminarian zone.

British Museum. S. P. WOODWARD.

MICROSCOPIC PRESERVES.

A SALT or fresh-water vivarium, maintained in the usual way, will afford a constant supply of microscopic objects; but it is, nevertheless, desirable to form special establishments for the purpose. These may consist of small masses of hay, or other vegetable matter, immersed in a tumbler of water and allowed to develop the germs they contain; or of aquatic plants placed in vessels of various sizes and kept through their stages of growth and decay. It is a popular error to suppose that water must be offensive in order to afford the requisite nutriment for infusorial life. It is quite true that water in that condition will exhibit certain forms, but the clear fluid in which vegetable organisms flourish is the natural abode of numbers of the most interesting species.

If, for example, a little duckweed and a small handful of bright green conferva, taken as it floats in the water, be placed in a glass jar and exposed, not to a broiling sun, but to a good light in a window, a continual and varied supply of objects may be obtained for many weeks. A very convenient vessel for this purpose is a glass *preserve jar*, and one seven inches in diameter and fourteen inches high, can be bought for one shilling. Several methods must be adopted for the examination of the contents. Dipping-tubes about one-eighth of an inch in diameter, some merely rounded at their edges, by holding for a few moments in the flame of a spirit lamp, and others with one end drawn out so as to reduce the aperture, will enable any particular object that is visible, or portions of sediment from the bottom, to be obtained with ease; while a piece of wire or slender stick will serve to take up a little of the duckweed or conferva. It may be as well to remind beginners that a dipping-tube is held between the thumb and middle finger, and the fore finger placed, by way of a stopper, at the top. In this position it is plunged into the water, and brought just over the object to be caught; the fore finger is then lifted and instantly replaced. In the interval a portion of water has rushed in, carrying the object with it, if the operation has been dexterously performed.

All parts of the glass vessel should be diligently searched, not forgetting any scum adhering to the sides; but a nearly certain supply of interesting objects may be obtained by taking up a single leaf of duckweed or a very few threads of conferva. These should be placed in the centre of the live-box and the cover gently pressed down. An inch or two-third object-glass, with the first eye-piece, will be most convenient to commence the examination, and when any object is found requiring a higher power, it may be obtained by the second or third eye-piece, and the use of the draw-tube, or, when necessary, by using a higher object-glass. It is often fancied that excessive magnifying is necessary for ordinary purposes, and uninformed persons are deluded into buying bad microscopes by wonderful accounts of their magnifying capacities, announced in superficial measure, which is never used for scientific purposes, as the information really wanted is given by stating the linear power. Thus, if an object is said to be magnified one hundred linear, it means that it is made to look one hundred times its natural length, but as the breadth is equally enlarged, the superficial magnification is 10,000 times. For examining infusoria and rotifers the most useful powers are from 60 to 150 or 200 linear. Higher powers are necessary for minute objects or details of creatures that can be kept tolerably quiet, and are sufficiently flat not to give a confused image, through the impossibility of bringing elevations and depressions into focus at once. This fact limits the use of high powers, and renders it extremely important, in the purchase of a microscope, that the one-inch or two-thirds should be an excellent glass.

To return to our microscopic preserve. Having formed one in the middle of March, in one of the jars mentioned, the first objects found in abundance on the duckweed and conferva were vorticellæ in all the stages described in the April number.

The conferva itself presented a beautiful appearance, abounding in specimens of the elegant *Spirogyra.* In this genus one or more brilliant green ribbons, coloured with chlorophyll (colouring matter of green plants), are spirally twisted round the cells of a clear glassy tube. When a number of these thread-like plants are placed under the microscope, illuminated by a rather oblique light, and magnified from 100 to 200 diameters, the effect is charming. In some parts the tangled mass shines like groups of living emeralds, and in others a delicate, cool, green, shadowy light reminds us of poetical pictures of the sea nymphs' haunts. If we remember that one drop of fluid is a world of water to the little beings that dwell therein, the scene will resemble that through which Shelley makes Arethusa pass when flying from the advances of her rude admirer, "Alpheus the bold:"

"Through the dim beams
Which amid the streams,
Weave a network of coloured light;
And under the caves,
Where the shadowy waves
Are as green as the forest's night."

In such a scene we saw, amid elegant forms, an uncouth-looking object of a dirty brown colour and a nondescript lumpish form. It was attached to a stalk of duckweed, and after a period of quiescence slowly elongated itself and changed its shape, until at last it assumed the extremely elegant appearance belonging to the stentors, which are close relations of the vorticellæ. A few of the different appearances of this protean creature are shown in the annexed drawings (Fig. 1),

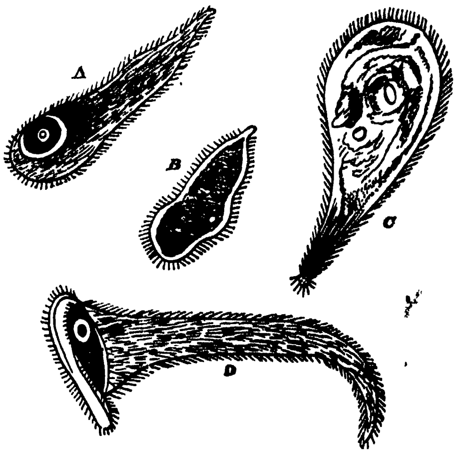


FIG. 1.—A, B, C, D, Stentor Mülleri in different degrees of expansion. A large specimen is one twenty-fourth of an inch long.

and if anybody should light upon one in his ugly aspect, let him wait till the seeming clodpole of the waters thinks proper to wear the shape of "old Triton's wreathed horn."

Three days after finding the stentor, another dip from near the surface of the water brought up a few threads of conferva less elegant than the spirogyra, but beautiful in their way. Attached to these were the graceful bottles, of which drawings are given (Fig. 2, B and C), and from which our glass and

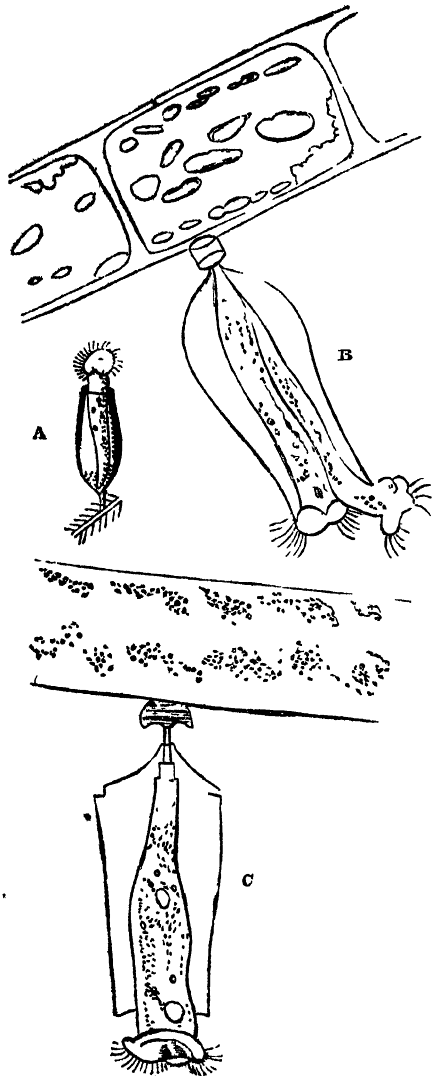


FIG. 2.—A, Cothurnia imberbis — ("Micrograph. Dict.") B and C, the specimens described in text. [illegible]ve the *linear* magnification.

crockery [illegible] might take a useful lesson. At the bottom of each bottle was a rough potato-like-looking thing which jerked its body in a sulky sort of fashion. It was, in fact, a "bottle imp," and apparently not in the best temper. A little repose soothed its troubled spirit, and presently the creature began to elongate itself and then jerked back again. At last good humour returned, and our ugly denizen of the bottle proved to be the graceful water-sprite, of which the annexed portrait (Fig. 2, B and C) will give a faint idea. It was evidently a *Cothurnia*, much like the species often found upon the shells of *Entomostraca*, of which one is figured (Fig. 2, A). Those which make their abode upon the bodies of the most lively and restless of animals must be amazingly fond

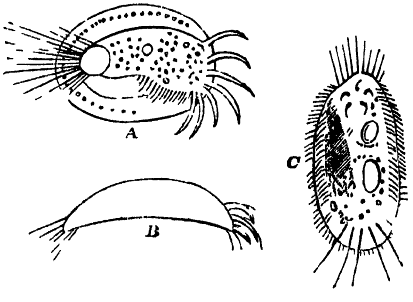


FIG 3.—A, Euplotes (patella), B, side view of ditto, C, Stylonichia.

of locomotion, and meet with many hard knocks in their restless journeys. They may be said to keep their carriage, or at least a nag, but we should prefer the taste of our present specimens, who hang their bottles upon the quiet plant.

Among other conspicuous inhabitants of the glass jar were numbers of that restless animalcule *Stylonichia*. This little creature can crawl or walk along vegetable stems by means of its spines, and by their help and those of its cilia swims rapidly and executes sharp and sudden turns. Its usual habit seems to be to go forward a little way and then dart backwards, but not equal to the distance advanced. This motion is continued by the hour, and after leaving the live-box undisturbed during the night, was scarcely less remarkable the next day. Another equally restless creature was the *Euplotes patella,* and of this, as well as of the former, sketches are annexed (Fig. 3).

But the gems of the collection were the rotifers, of which six or eight kinds were discovered. One of the oddest was a *Metopidia**, sometimes using the beak-like termination of its head after the manner of a pick-axe, and sometimes raking up the vegetable refuse with it, as a gardener might use a sickle to turn over a quantity of small twigs he had cut from a hedge. The figures appended (Fig. 4) will show the nature of this curious

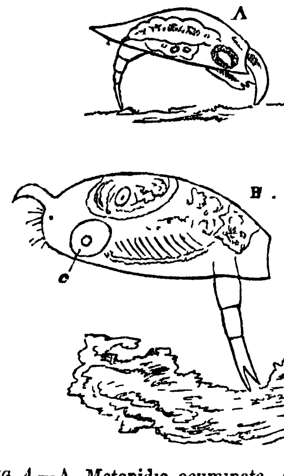


Fig. 4.—A, Metopidia acuminata, as drawn by Mr. Gosse. B, Specimen as seen and described in text, c, Mouth or gizzard.

animal; and not less strange is the *Monocerea rattus* (so called from having a body and tail something like a rat), now swimming freely, now spinning round and round like a cat running after its tail, and playing a number of antics very comical to behold.

It would occupy too much space to describe the remaining rotifers, but some, like the *Diglena* and *Salpina,* were remarkable for their habit of thrusting out the so-called gizzard, which Mr. Gosse affirms to be a mouth, and using it in a manner characteristic of the latter organ; and one presented features which we must stop to detail. This was the *Floscularia ornata,* or "Beautiful Floscule" (Fig. 5), one of the most irregular and fascinating creatures with which the microscopist is acquainted, although, like many other exquisite things, it may not prove attractive at first sight.

Those who have Mr. Gosse's "Tensy" at hand, will find, opposite page 308, an exquisite drawing of the "Beautiful Floscule," sketched and coloured with that eminent naturalist's peculiar skill. If after looking at this portrait, drawn when the original was seen as an opaque object by reflected light, the observer should chance to see the creature itself under ordinary conditions, he would scarcely recognize it, but it is nevertheless admirably true. The best way of explaining this discrepancy will be to describe the discovery and successive appearances of the specimen delineated. A leaf of duckweed was under the microscope in the live-box, and, after a little time, a dingy brown creature, upon a long stalk, was observed in slow motion. Was it a species of stentor? It might be; but no. From its head were extremely fine, scarcely visible threads, extending to an extraordinary length. This indicated a probability of its being a Floscule; but, if so, only a peculiar and careful illumination could render it properly visible. Accordingly the mirror was moved up close under the stage, and turned on one side, to throw so oblique a light as to exhibit the animal as a brilliant object upon a dark ground. By this means its whole

* Mr. Gosse says of this creature:—"The frontal region is formed by an arched fleshy process occipitally, which is approached by a small one on the mental (chin) side; and between them is the side entrance of the buccal (mouth) funnel. The occipital process is protected by a horny, crystalline plate, forming a segment of a sphere, and, when viewed laterally, taking the appearance of a curved horn. It can be partially protruded and retracted, and also bent down to meet the mental lobe."—*Phil. Trans.*

aspect was changed; its colours became bright, and, with very careful focussing, the extremely transparent jar in which it lives, and which naturalists choose to consider a cerropore, became sufficiently visible to be discerned. The moment the Floscule is disturbed by the abrupt passage of one of her fidgetty companions, or by a sudden shaking of the table, she retracts her head and slowly withdraws into her house, somewhat after the manner in which the vorticellæ retire, but the motion is not so rapid nor so jerkish. With the oblique dark-ground illumination, the long cilia looked like threads of green spun glass. At first they were steadily protruded, as represented in the drawing, and looked very lustrous as they slowly moved. Then the motion quickened, and the long cilia seemed to fall on all sides like a shower of emerald hair. By striking the knuckle sharply on the table the Floscule drew herself in again, but immediately began to come out, so that the elegant process was repeated as often as desired.

When first seen their eggs were very noticeable, and after an hour one appeared to stretch itself, and walk out of the bottle. This was the young Floscule; the egg-shell itself escaped observation from its transparency. The young thing moved quickly with an uncertain gait, as if it did not know what to do, and was puzzled with its first entrance into life. After a few seconds its movements evinced more purpose, and the little creature twisted its tail end about as if trying to find out the use of that organ. After a little while it eluded notice, but the next day was discovered a thriving young infant, as in Fig. 5.

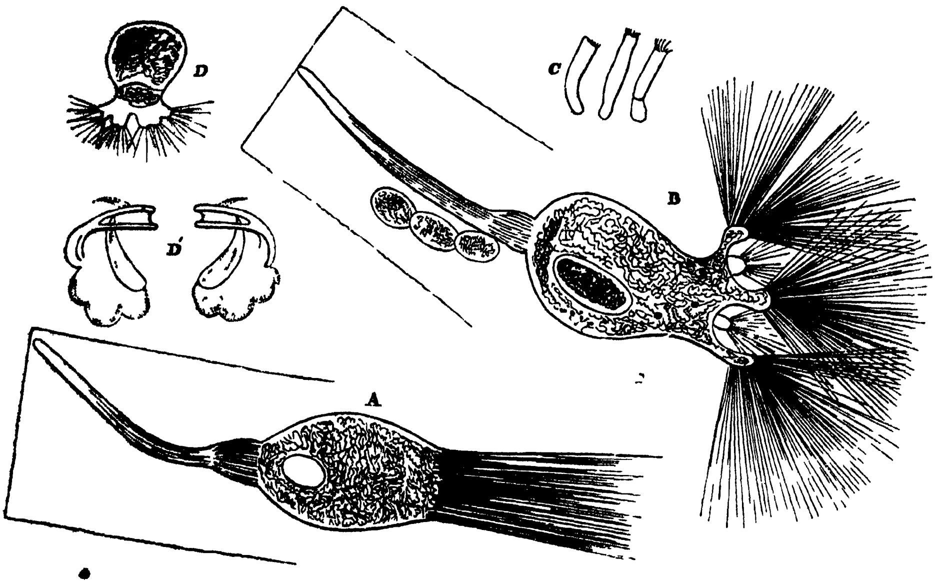


FIG. 5.—The Beautiful Floscule (*Floscularia ornata*). A, partially protruded, B, freely ditto, with three eggs; C, first appearance of young; D, Floscule seventeen hours old, D', jaws of Floscule as figured by Mr. Gosse.

Ehrenberg and Dujardin differed as to the number of lobes fringed with the long hairs which this animal exhibits, and it is, in fact, much more difficult to count them than might be supposed. During the first evening five lobes were distinctly visible, and only once did there appear a suspicion of a sixth. The next day only four could be seen for some time, and then all six appeared. The long cilia scarcely move when fully extended, and Mr. Gosse considers that the real rotary organs "are set in the inner surface of the disk." So quiet do the long cilia keep that a small object remained in the same place, as if attached to them, for a considerable time, although the moment they were made to move, by striking the table, it was thrown aside.

Mr. Gosse, speaking of the tube, observes —"There is evidently no organic connection between it and its inhabitant. It is a thick gelatinous excretion from the body, thrown off in successive rings, and hence the lower parts are more dense, the summit or edge being so attenuated as to melt imperceptibly into the surrounding water. In old specimens the tube is sometimes more distinct, owing to the entanglement of floccase atoms, small diatoms, and other floating matters in its viscid surface." The young Floscules have two red eyes, which usually disappear in adults, but Mr. Gosse says he has occasionally met with specimens apparently of full age in which they were plainly visible. There are several species of Floscularia, varying in size, according to the "Micrographic Dictionary," from $\frac{1}{15}$th to $\frac{1}{100}$th of an inch in length. Mr. Gosse says that the organs of the mouth (gizzard) reach their minimum of development in *Floscularia* and *Stephanoceros*, and we append a copy of his drawing of the simple mechanism with which the former is provided.

In this paper only a few particulars have been given of a portion of the living forms, dwelling upon three or four leaves of duckweek and a few threads of confervoid plants. The whole would not have covered a threepenny piece, and the water taken with them would not weigh a dozen grains. Myriads of such small plants may be found in common ponds. All the human inhabitants of the earth are outnumbered by the residents in many a puddle, and we can scarcely examine a leaf or a water-drop without finding exhibitions of animal life which amaze us by wonderful arrangements of structure and adaptations of means to ends. If life is found in all places, from ocean beds to snowy alpine summits, beauty is no less omnipresent; every manifestation of creative intelligence which man can contemplate unfolds the principles of Art, and opens a page in Nature's everlasting song.

HENRY J. SLACK.

THE PRINTING PROCESS IN PHOTOGRAPHY.

HAVING procured good negatives, it is important to be able to get good prints from them, and, although the process of printing is a simple matter, we often see very bad prints taken from what are evidently good negatives; the operator seems to have paid all the care and attention he can to his negatives, and then to have hurried over the printing, thinking it of no importance. Those who have collected photographs for the last eight or ten years, cannot look over their portfolios without feeling considerable annoyance; many of the once beautiful specimens are now mere shadows in yellow and brown, many are spotted and partially faded, and comparatively few are in their original state. Fortunately the cause of this destruction is now well known, and we need not fear the fading of our photographs, if the printing be properly conducted. This is not the place to enlarge on the causes of fading; it will be sufficient to say that photographs toned or coloured with chloride of gold appear unalterable, and those coloured with sulphur, from the decomposition of the hyposulphite of soda bath, are almost certain to fade in time.

The writer has some prints he toned with chloride of gold in 1852, which are as beautiful as on the day they were printed; whilst of those toned with hyposulphite of soda, or, as it was called, "old hypo," few are in existence, and none are in their original state. Unfortunately the latter process was used extensively from 1852 to 1858, being cheaper and easier to work than the other, consequently a large proportion of the prints produced between these periods have already faded, or will sooner or later do so.

The first process, "albumenizing the paper," is not worth the attention of an amateur, unless he have plenty of time at his disposal. "Papier saxe" albumenized is to be obtained very good; but it is well to try a sheet or two before procuring a supply, as there is a quantity of rubbish in the market, apparently coated with a mixture of albumen and glue, on which it is impossible to produce a good print. A pressure frame and three earthenware dishes will be wanted: also the following solutions:—

EXCITING SOLUTION.

Nitrate of silver	100 grains.
Distilled water	1 ounce.

TONING SOLUTION.

Water	8 ounces.
Carbonate of soda	8 grains.
Chloride of gold	1 grain.

FIXING SOLUTION.

Water	20 ounces.
Hyposulphite of soda . . .	6 ounces.

Among the different modes of rendering the paper sensitive, the two following are perhaps the best, the first when a considerable number of papers are to be prepared, the second when only a few are wanted at a time:—

1. Pour the nitrate of silver solution into one of the dishes, float the sheets one at a time on the surface, taking care that there be no bubbles underneath; let the sheet remain four or five minutes, and then pin up to dry in the dark-room; the pins used should be coated with varnish.

2. When only a few prints are wanted the *glass rod* (Fig. 1) is the most convenient

FIG. 1.—Bent Glass Rod.

instrument to use; there is no waste of nitrate of silver, and all the requisites can be got out, the paper rendered sensitive, and the various articles replaced in a few minutes.

For papers 11 × 9 inches, measure out half a drachm of the silver solution into a clean glass, spread on the table a couple of sheets of blotting-paper, and lay the sheet to be prepared on it (Fig. 2); then with the right

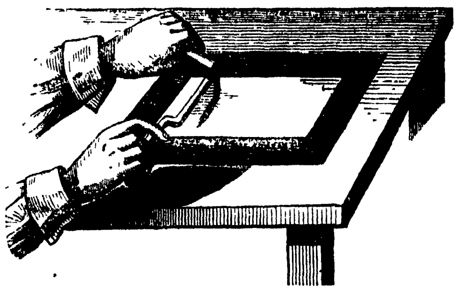


FIG. 2.—Preparing Paper with Glass Rod.

hand take the glass rod, and with the left pour on the solution, then move the rod over the paper, driving the solution before it, and then backwards and to the edges, so as to wet the surface equally all over. Continue this until the paper has absorbed the fluid, and then hang it up in the dark-room to dry. With some descriptions of paper a little more than half a drachm is required; this can only be ascertained by trial.

A little practice is requisite to use the glass rod neatly; a beginner often presses too hard with the rod, and rubs up the albumen into a froth. A few trials are requisite, to show the amount of pressure required to distribute the solution without disturbing the surface.

... *quite dry*, the paper may be put into the pressure-frame with the negative, and printed until rather darker than it will be required when finished. Then wash the print in water several times, until the water used no longer looks milky; then place it in the toning solution in a dish, and agitate it a little. The print rapidly changes colour, and when it is of the tone required, take it out and place it in the fixing solution for five minutes, and afterwards wash in many changes of water, and hang up to dry. The black or the sepia tone is owing to the print being a longer or shorter time in the toning-bath. The eight ounces of toning solution will tone five prints of 11 × 9 inches, after which it may be thrown away as worthless, all the chloride of gold having been abstracted.

If the photographs are mounted on cardboard, or pasted into a book, *freshly-made* paste should be used for the purpose.

JOSEPH SIDEBOTHAM.

Manchester.

THE STRUCTURE AND MOVEMENTS OF COMETS.

PERIODIC COMETS.

THE comets which we propose treating of in the present paper are usually divided into the three following classes:—

I. Comets of short period.

II. Comets revolving in about seventy years.

III. Comets of long period.

The following are the comets belonging to Class I., with which we are best acquainted:—

Name.	Period.	Next Return.
1. Encke . . .	3·296 . .	1862, Feb.
2. Di Vico . . .	5·469 . .	1861, Jan.
3. Pons (1819, iii.)	5·54 . .	1863, Nov.
4. Brorsen . . .	5·581 . .	1862, Oct.
5. Biela	6·617 . .	1866, Jan.
6. D'Arrest . .	6·64 . .	1863, July.
7. Faye	7·44 . .	1866, Feb.
8. Méchain (1790)	13·60 . .	1871, Oct.

No. 1 is by far the most interesting comet in the list, and we shall therefore review its history somewhat in detail. On the evening of November 26, 1818, M. Pons, of Marseilles, detected a telescopic comet: it was soon found that its orbit could not be parabolic. Professor Encke was, therefore, induced to undertake a rigorous investigation of its elements; and he ascertained that the real path of the comet was an ellipse, with a period of about three years and a quarter (Fig. 1). On looking over a catalogue of all the comets then known, he was struck with the similarity which the elements obtained by him bore to those of the comets of 1786 (i.), 1795, and 1805; further examination placed beyond a doubt the identity of those comets with the one of 1819. Encke then turned his attention to its next return, and he announced that the comet would arrive at perihelion (or its least distance from the sun) on May 24, 1822, after being retarded about nine days by the influence of the planet Jupiter.

FIG. 1.—Encke's Comet, 1828, on Nov. 30. Nucleus eccentric. (Telescopic view.)

"So completely were these calculations fulfilled, that astronomers universally attached the name of 'Encke' to the comet of 1819, not only as an acknowledgment of his diligence and success in the performance of some of the most intricate and laborious computations that occur in practical astronomy, but also to mark the epoch of the first detection of a comet of short period—one of no ordinary importance in this department of the science." Agreeably to Encke's prediction, the comet arrived in 1822; and has been observed at every successive return since that time, viz., 1825, 1828, 1832, 1835, 1838, 1842, 1845, 1848, 1852. 1855, 1858.

The account of this comet would be incomplete, were we not to refer to a peculiarity connected with its motion, which attracted Encke's attention as far back as 1838. He found that, notwithstanding every allowance being made for planetary influence, yet the comet always attained its perihelion distance about two hours and a-half sooner than his calculations led him to expect. In order to account for this gradual diminution of the period of revolution (in 1789 it was nearly 1213 days, but in 1858 it was scarcely 1210½), Encke conjectured the existence of a thin ethereal medium, sufficiently dense to produce some impression on a body of such extreme tenuity as the comet in question, but incapable of exercising any sensible influence on the movements of the planets. This contraction of the orbit must be continually progressing, if we suppose the existence of such a medium; and we are naturally led to inquire, What will be the final consequence of this resistance? Though the catastrophe may be averted for many ages by the powerful attraction of the larger planets, especially Jupiter, will not the comet be at last precipitated on to the sun? The question is full of interest, though widely open to conjecture.

No. 2. On August 22, 1844, M. di Vico, at Rome, discovered a telescopic comet, whose orbit was afterwards proved to be an ellipse of moderate eccentricity, with a period of about five years and a-half. The return of this comet to perihelion was predicted for March, 1851; but owing to its unfavourable position, it was not seen. Le Verrier has made some computations which render it probable that this is a return of the comet of 1678.

No. 3 was discovered by M. Pons on June 12, 1819. Professor Encke assigned to it a period of five years and a-half, which, as the table will show, was a very close approximation to the truth. It was not, however, seen from that time till March 8, 1858, when it was detected by Dr. Winnecke at Bonn, who soon ascertained the identity of the two objects.

No. 4 was detected by M. Brorsen at Kiel, on February 26, 1846. The observations showed an elliptic orbit, and the epoch of the ensuing arrival at perihelion was fixed for September 26, 1851. It escaped observation in that year, however, owing to its proximity to the sun; but was rediscovered by Dr. D'Arrest in February, 1857.

No. 5. This is another very remarkable periodic comet, and second only in interest to Encke's. It was discovered in Bohemia by M. Biela, on February 27, 1826; the path it pursued was observed to be similar to that of the comets of 1772 and 1807, with which it was subsequently identified. It was followed by Dr. Olbers and M. Gambart until the end of April. Soon after its disappearance, Professor Santini of Padua undertook to investigate its motion, and announced that its perihelion passage would take place on November 27, 1832. The first glimpse of the comet on its return was obtained at Rome on August 23, and in a few weeks it became generally visible. It arrived at perihelion only twelve hours before the time named, a much closer fulfilment of Santini's prediction than could have been expected under the circumstances. Considerable sensation was created among the general public on this occasion, on account of an apprehended collision with the earth; but none of course took place, a result which astronomers in vain tried to prove beforehand. We have already adverted to a very curious phenomenon which took place at the apparition of this comet in 1845, shortly after its discovery in that year.

No. 6. On June 27, 1851, D'Arrest discovered a faint comet in the constellation Pisces. It was soon remarked by this astronomer that the path followed by the comet appeared to be an elliptic one—a surmise which subsequent observations fully confirmed. Calculation showed that it would probably reappear about the end of 1857, or beginning of 1858; and although not seen in Europe, it was discovered by Sir T. Maclear at the Cape of Good Hope, near the time fixed.

No. 7 was discovered by M. Faye, on November 22, 1843, at the Paris Observatory. It exhibited a bright nucleus, with a short tail, but was never sufficiently brilliant to be seen by the unaided eye. It was soon found by several observers to be moving in an elliptic orbit, with a period of about seven years and a-half. M. Le Verrier predicted the comet's return to perihelion for April 3, 1851; and, true enough, it was detected in the great Northumberland telescope at Cambridge, by Professor Challis, on November 28, 1850, and passed through the perihelion near the time named some years before.

No. 8 was detected by Méchain, January 9, 1790; but the elliptic nature of its orbit does not appear to have been then suspected. It was not reobserved until its return, at the commencement of 1858.

Short periods have also been assigned to the following comets; but, since much uncertainty prevails about them, they have not been included in the above list:—

Clausen (1743, i.)	Pigott (1783).
Burckhardt (1766, ii.)	Blainpain (1819, v.).
Lexell (1770, i.)	Peters (1846, vi.).

In Class II. we have the following comets:—

Name.	Period.	Probable next Return.
1. Westphal (1852, iv.)	67·77	1920
2. Pons (1812)	70·68	1883
3. Di Vico (1846, iv.)	73·25	1919
4. Olbers (1815)	74 05	1889
5. Brorsen (1847, v.)	74·97	1922
6. Halley	76 78	1912

It has been thought by some astronomers that four of the above may have originally constituted a single comet.

No. 6. The comet whose history is the most interesting is undoubtedly that which bears the name of our illustrious countryman, Halley, which has a period of about 75 years; and as it will, moreover, serve to exemplify what we have already said on the nature and appearance of comets, we cannot do better than give a summary of its history, from the time of its last appearance, in 1835, back to the earliest ages. Four years after the advent of the celebrated comet of 1680, Sir Isaac Newton published his "Principia," in which he applied to that body the general principles of physical investigation first promulgated in that work. He explained the method of determining, by geometrical construction, the visible portion of the path of a body of this kind, and invited astronomers to apply these principles to the various recorded comets. Such was the effect of the force of analogy upon the mind of the great philosopher, that, without awaiting the discovery of a periodic comet, he boldly assumed these bodies to be analogous to planets in their revolutions round the sun. Startling as this theory might have been when first propounded, yet it was not long before it was fully substantiated. Halley, who was then a young man, undertook the labour of examining the circumstances attending all the comets previously recorded, with a view to ascertain whether any, and which of them, appeared to follow the same path. Careful investigation soon pointed out the similarity of the orbits of the comets of 1531 and 1607, and that they were, in fact, the same as that followed by the comet of 1682, seen by himself; he suspected therefore (and rightly too, as the sequel showed), that the appearances at these three epochs were produced by the three successive returns of one and the same body, and that, consequently, its period was somewhere about 75½ years. There were, nevertheless, two circumstances which might be supposed to offer some difficulty, inasmuch as it appeared that the intervals between the successive returns were not precisely equal; and, secondly, the inclination of the orbit was not exactly the same in each case. Halley, however, "with a degree of sagacity which, considering the state of knowledge at the time, cannot fail to excite unqualified admiration, observed that it was natural to suppose that the same causes which disturbed the planetary motions would likewise act on comets;" in other words, the attraction of the planets would exercise some other influence on comets and their motions. The truth of this idea we have already seen exemplified in the case of the comet of 1770. In fine, Halley found that in the interval between 1607 and 1682, the comet passed so near Jupiter that its velocity must have been considerably increased, and its period consequently shortened; he was, therefore, induced to *predict* its return about the end of 1758 or the beginning of 1759. Although Halley did not survive to see his prediction fulfilled, yet, as the time drew near, great interest was manifested in the result, more especially as Clairaut had named April 13, 1759, as the day on which the perihelion passage would take place. It was not destined, however, that a professional astronomer should be the first to detect the comet on its anticipated return; that honour was reserved for a farmer, near Dresden, named Palitzch, who saw it on the night of Christmas-day, 1758. But few observations were made before the perihelion passage (on March 12), owing to the comet's proximity to the sun; during the months of April and May, however, it was seen throughout Europe, although to the best advantage only to the southern hemisphere. On May 5 it had a tail 47° long.

Previous to the last return of this comet, in 1835, numerous preparations were made to receive it. Early in that year Professor Rosenberger of Halle published a memoir, in which he announced that the perihelion passage would take place on November 11, though Damoiseau and Poulécoulaut both fixed upon a somewhat earlier period.

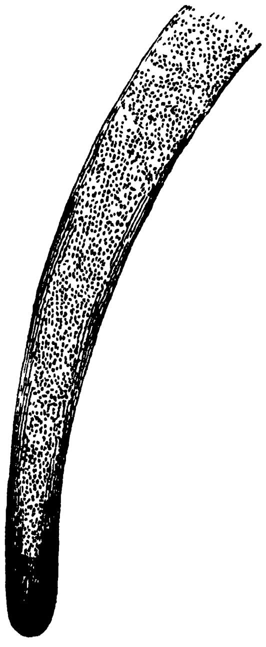


Fig. 7.—Halley's Comet, 1835 on October 29. (Telescopic view.)

Let us now see how far these expectations were realized. The comet was seen at Rome on August 5; as it approached the sun it gradually increased both in magnitude and brightness, but did not become visible to the naked eye till September 20. On October 19 the tail had attained a length of fully 30°. The comet soon after this was lost in the rays of the sun, and passed through its perihelion on November 15, or within four days of the time named by M. Rosenberger. It reappeared early in January, 1836; and was observed in the south of Europe and at the Cape till the middle of May, when it was finally lost to view, not to be seen again till the year 1912.

We have seen above that Halley traced his comet back to the year 1531; we must now, therefore, briefly review its probable history prior to that date, as made known by the labours of modern astronomers. Halley surmised that the great comet of 1456 was identical with the one observed by him in 1682, and M. Pingré has converted Halley's suspicion into a certainty. The preceding return took place, as M. Laugier has shown, in 1378, when it was observed both in Europe and China; but it does not appear to have been so bright as in 1456. In September, 1301, a great comet is mentioned by nearly all the historians of the period. It was seen as far north as Iceland. It exhibited a bright and extensive tail, stretched across a considerable part of the heavens. This was most likely Halley's. The previous apparition is not so well ascertained, but most likely occurred in July, 1223, when it is recorded in an ancient chronicle that a wonderful sign appeared in the heavens shortly before the death of Philip Augustus of France, of which event it was generally considered to be the precursor. It was only seen for eight days. Although but little information is possessed about it, and that of a very vague character, yet it seems probable that this was Halley's comet. In April, 1145, a great comet is mentioned by European historians, which is one of the most certain of our series of returns. There is considerable probability in favour of the appearance of the comet in the year of the Norman Conquest, or in April, 1066. The famous body which astonished Europe in that year is minutely, though not very clearly, described in the Chinese annals; and its path there assigned is found to agree with elements which have great resemblance to those of Halley's comet. In England it was considered the forerunner of the victory of William of Normandy, and was looked upon with universal dread. It was equal to the full moon in size, and its train, at first small, increased to a wonderful length. Almost every historian and writer of the eleventh century bears witness to the splendour of the comet of 1066, and there can be but little doubt but that it was Halley's. Previous to this year the comet appeared in 989, 912, 837, 760, 684, 608, 530, 451, 373, 295, 218, 141, 66, and 11, all of which apparitions have been identified by Mr. Hind. ("Month. Not. R.A.S.," vol. x.)

Concerning the comets belonging to Class III, it is unnecessary to notice them further on the present occasion.

Of hyperbolic comets, the following are the only ones yet known:—

1729	. . .	1818 (iii.)
1771	. . .	
1774	. . .	1840 (i)
	1843 (ii.)	

Eastbourne. GEORGE F. CHAMBERS.

THE HIGH TIDE OF THE SIXTEENTH OF SEPTEMBER, 1860.

THE tides once were pompously styled the "Grave of Human Curiosity." Now-a-days, thanks to Laplace, men are presumptuous enough to predict their date and proportions several years beforehand, to the great convenience of coasting trade and travelling intercourse. Nay, more; from the attractive action of the sun and moon on the liquid sheet which covers three-quarters of the globe, the great French astronomer deduced a very close approximation to the mass of our satellite. He weighed the moon in the ocean which envelopes the earth.

The tides are a necessary consequence of the great Newtonian law of universal attraction. All bodies exercise upon all other bodies an attraction which is directly proportional to their mass; that is, the larger a body is, the greater is the force of attraction which it exerts. The words "weight" and "heaviness" are only forms of expressing the power of attraction which the mass of the earth exercises on substances at or near its surface which lie within our cognizance. Consequently, our pound-weight would weigh much less than a pound if carried to the surface of the moon, and much more than a pound if carried to the surface of the sun; because the mass of the moon is considerably less, and the mass of the sun considerably greater, than the mass of the earth.

Again: the attraction exercised by any body varies inversely as the square of the distance from that body. "Varying inversely" means that, in proportion as the distance of the body is greater, its power of attraction is less. The square of any quantity is that quantity multiplied by itself: 9 is the square of 3; 16 is the square of 4. It will be seen, therefore, that the attraction exerted by a body diminishes very rapidly with increase of distance. At two distances denoted by the proportions of the numbers 3 and 4 (miles, hundreds of miles, or any other measure of length), the corresponding attractions will be in the respective proportions of 16 to 9; the attractive force will be nearly one-half less, while the distance from the centre of attraction is only one-quarter more.

The knowledge of these two grand laws of the universe enables astronomers to calculate the force of attraction which the heavenly bodies exercise on each other. Now, the sun and the moon are heavenly bodies, the one of sufficient magnitude, the other sufficiently near, to exercise a perceptible power of attraction on the earth, and on every particle of matter of which it consists. The watery portion of the earth is that in which obedience to the force of attraction is most easily and unmistakably visible. We witness its results in the phenomena of tides. It is to our own great Newton that we are indebted for this clue to the mystery. Galileo made light of Kepler's idea that the daily and periodical advance and retreat of the waves of the sea were owing partly to the action of the moon, and partly to the changes which the daily rotation of the earth, combined with its revolution round the sun, produced in the actual motion of every liquid particle on the globe.

Newton supposed (to explain his theory) the earth to be completely covered with a fluid of the same density as itself. He then showed that this fluid, under the action of the sun, must assume the form of an ellipsoid, whose major axis would always be directed towards the great luminary. But the action of the moon on the ocean also produces an ellipsoid similar to that caused by the action of the sun, only more elongated; because the lunar action (in consequence of her closeness) is more potent than that of the sun.

It will be easily understood that if the two separate attractions of the sun and the moon are combined, the waters will be raised higher, and there will be great, or spring-tides. If the attractions are in opposite directions, the waters will not be raised so high either way, and then feeble, or neap-tides will take place. Accordingly, we find that when the moon is in conjunction or opposition in the same line with the earth and the sun, which is called being in the syzygies,* and which occurs at new moon and at full moon, the axes of the two ellipsoids will coincide, and the highest tides will happen. The sun and the moon are agreed; they are both pulling one way. On the other hand, when the moon is in her quadratures, or at the first or the third quarter, the axes of the two ellipsoids are perpendicular to each other, and the two effects tend to neutralize one another.

* Syzygy is derived from a Greek word, συζυγια, signifying conjunction, conjugation, the being coupled in the same yoke. Quadrature explains itself; the moon, earth, and sun are in a *square* position. They form together a right angle, the earth being in the corner.

The moon and the sun are pulling different ways; it is a house divided against itself. The tides, on this simple supposition of Newton's, would be a comparatively easy problem.

But the ocean does not cover the whole surface of the earth; the declinations of the sun and the moon vary greatly, that is, sometimes they ride high in the sky, sometimes creep close to the horizon; the mass of waters are continually rushing onwards in obedience to the attractions of the sun and the moon, and are consequently still impelled by their acquired velocity in a certain direction at the moment when the direction of the attractive force is changed; the different seas are of different forms and different extent, and communicate with each other by channels of divers depths and breadths; the friction of the waters against the sand or rocks at the bottom, and of currents of wind at the surface, also exert some influence on the ebbing and flowing of the sea. Newton's theory of the tides, true in principle, required to be elaborated to make it applicable to practice. Laplace succeeded in giving the true solution; he demonstrated that attentive observations, continued for years in different localities, combined with the results of theory, would enable us to predict almost all the details of future tides, for a considerable time beforehand, with mathematical certainty.

We have seen that the combination of the two separate tides occasioned by the sun and the moon respectively, occurs at the syzygies, at the new moon and the full. The combined tide may be very high; for it is the sum of two distinct tidal waves. But the tides of the syzygies are not all equally strong; because the distinct tides which concur in their production vary with the declinations of the sun and the moon (their distance from the equator), and with the distance of those luminaries from the earth. The nearer that both the sun and the moon are to the plane of the equator (which occurs at the equinoxes), the greater are both the lunar and the solar tides. At the high tide of the 9th of March last, the moon was *on* the equator, and the sun only 5° to the south of it; and for the production of high spring-tides, the moon's close approach to the equator is of more importance than the sun's, the tidal wave caused by the moon alone being three times as high as that produced by the sun alone.

There is a new moon on the 15th of this month, at nine minutes past six in the morning. But it is found that the combined action of the sun and the moon on the waters of the ocean does not produce its greatest effect on our coasts until some six-and-thirty hours after new and full moon, varying according to the locality of the port. The high tide, therefore, will occur on Sunday, the 16th, at about seventeen minutes before noon, at Dover; at about half-past eleven at Liverpool; and at times which will differ along the whole line of our coast. There is no need here to give a tide-table for all the ports and watering-places in Great Britain and Ireland.

Theoretically, the spring-tide of the 16th September, 1860, is not expected to be quite so high as that of the 9th of March; but it would be very imprudent to despise it on that account, or to neglect precaution in places exposed to inundation or accident. Practically, if favoured by winds, it may turn out greater in some places than its predecessor, which was so inconsiderately abused for not having done more damage, showing the admiration which the vulgar feel for great destroyers and irresistible conquerors. And there is no tyrant so relentless as an irruption of waters.

Every one who has visited the coast must have observed that the time of high and low water varies from day to day, till it comes round again to nearly the same hour and minute. The mean daily retardation of the tides is 50½m. The mean interval between two consecutive high-waters is 12h. 25m The intermediate low-water is not exactly in the middle between two high-waters: the sea takes a longer time to flow than it does to ebb. The retardation of the tides varies with the phases of the moon: it is the least possible, or 39m., at the syzygies; when the tides are highest, at the quadratures; when the tides are neap, it is the greatest possible—as much as 75m. The highest tides occur at the equinoxes, when the moon is in her perigee, or at her shortest distance from the earth, and never far from the equator. The weakest tides happen at the solstices, near the longest and the shortest days, when the position of the moon is quite the reverse of the former case.

As at spring-tides the sea retires in proportion to the height it has risen, the ebb and low-water of the 16th will afford an excellent opportunity to naturalists and collectors for marine aquariums. Many objects not usually laid bare, such as red sea-weeds, rare sea-anemones, and an infinity of curiosities, will be to be had for the trouble of taking. Rocky coasts will prove especially interesting in their revelations of marine life in deep waters. But the inexperienced amateur is earnestly warned not to let his enthusiasm lead him into danger, but to note the first symptom of the rising tide, and to select localities where his retreat cannot be cut off by the flowing waters. The writer of this gives the caution taught by experience. He once had a narrow escape from having to choose which of the two he would save from drowning—his own daughter, or a lady who *would* linger in a nook at the foot of a perpendicular cliff of rock, till the trio were caught in a trap by the advancing waves. A few decided steps placed Mademoiselle in safety by doubling a point after the fashion of the wading birds, with the water rising above the knees. Madame, still loitering and irresolute, and with all presence of mind utterly gone, had to be dragged out of her perilous plight, just in time, when the water was mounting fast to her shoulders.

E. S.

NEW VARIABLE STAR.

On April 16th a small star, of the 11th degree of magnitude, was seen for the first time, in the constellation Ophiuchus, in a position where no star had been previously known to exist—since 1853 at least.

The observer, Mr. N. Pogson, of the Hartwell Observatory, at first conjectured that he had found a new planet, but the absence of any motion at once upset this idea. The position of the star for :

R.A. . . .	16h. 25m. 43·85s.
Decl. . . .	15° 49′ 49·8.″

The following observations show the variability of this star:—

April 16, 1860	11·0 mag.
„ 17	11·0
„ 20	10·8
„ 21	10·5
May 26, not visible, and under	12·5
„ 28, not visible, and under	13·0

G. F. C.

CAUSE OF LOW TEMPERATURE UPON MOUNTAINS.

The low temperature prevalent upon mountains is too well known even for mention, but with the cause of this the multitude are anything but familiar. I doubt, indeed, whether scientific men properly explain this phenomenon, for which reason I would advance a few observations concerning it. It is, of course, clear that the height of mountains is either directly or indirectly the cause of the low temperature surrounding them. There does not appear to me any reason for supposing that a direct influence is exerted, and I am therefore compelled to believe that the attenuation of the atmosphere produces the superior cold. It is very probable that the property which the atmosphere possesses of conducting heat decreases with its attenuation. I think, indeed, that upon the earth's surface this has been proved.

J. J.

WAYSIDE WEEDS AND THEIR TEACHINGS.

HANDFUL IV.

"By the primrose stars in the shadowy grass."

Handful of Favourites—They are One-petaled—Distinction from last Handful—Our Botanical Position in Handful IV.—Free and attached Stamens—Primroses and Forget-me-nots—Pimpernel and Loosestrife—The Primula Tribe—The Veronica and its Relations the Figworts—The Labiates, or Lipped Flowers—Convolvulus—The Plantain and its packed-up Stamens.

When we come to look into Handful IV., we find we have got in the midst of a whole host of well known favourites—regular playfellows, almost, which seem to have grown up with us from childhood, though many a fair generation of blossoms—we almost fear to think how many—has come and gone since some of us first gathered primroses or cowslips in May, forget-me-nots in full summers' flushing, heather from the purple hills of August, or holly to deck the rooms in those days when mince-pies and plum-pudding had their special relish and their special impunity, or before we cared to know to what division, family, or genus the botanist assigned our favourites; but now, that is just what we want to know, so let us see, in the first place, what we have got. Heath-flowers and heather; the holly, though many of our readers, probably, know the leaves and berries better than they do the blossoms; convolvulus, or bindweed, or lap-love, for it has all those names (Fig. 71); forget-me-not (Fig. 68), sufficiently well known to every youth who has consigned his heart to the keeping of some fair maid, and, for that matter, sufficiently well known to the fair maids themselves. Next have we the veronica, speedwell, or Venus's looking-glass, of real heavenly blue. The mint family, with the red and white dead-nettles, the wild thyme, and the self-heal (Fig. 62) come next; then our friends the primrose and the cowslip, and, with them, the scarlet pimpernel, or poor man's weather-glass, which closes its brilliant petals long before the coming storm. Lastly

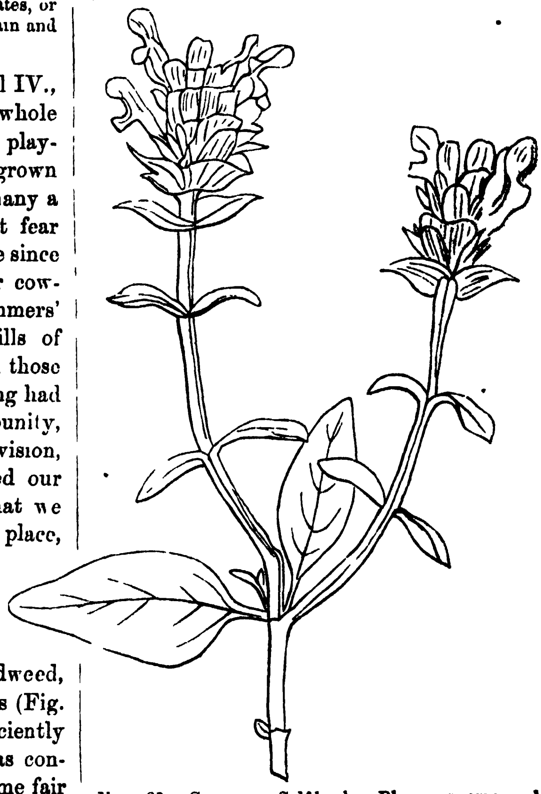


Fig. 62.—Common Self-heal. Blossoms arranged spike-like, in whorls, within coloured bracts. The irregular, lipped blossoms, the irregular calyx, the square stem, and the opposite leaves, are all characteristics of the Labiate family.

we have plantain for the bird-fancier, and the pink-headed thrift of seaside wastes, but perhaps more familiar as a bordering to old-fashioned flower-beds. We have a rare Handful this time, almost the best of our series, and were we not afraid of increasing its dimensions beyond our grasp, we might have graced it with more well-known blossoms still, such as the conspicuously handsome foxglove race; but we have enough and to spare for our lesson.

It does not need much dissection of our blossoms to tell us that we have all monopetalous corollas, and indeed that bright blue veronica (Fig. 63) does not wait for our dissecting, but insists on casting off its corollas all in a piece, with the two stamens adhering. They are thoroughly *deciduous* corollas. The rest of our flowers are not quite so precipitate in their proceedings, but there is not one we have named which will not at once disclose its monopetalous character to the most cursory examination. One-petaled, therefore, are our present flowers, like those of our last Handful; but the attachment of the corolla is like that of our first-examined blossoms of the many-petaled families—namely, to the receptacles beneath the ovary, and not to the calyx. Our present plants, therefore, belong to the one-petaled "Corollifloræ" section, in contradistinction to the one-petaled Calycifloræ. Now, before going further, let us get a clear idea of where we are in the botanical world. We made our entrance into it, as you may remember, by examining plants* which had blossoms in many distinct pieces, whereof the buttercups and their relations were prominent examples, the blossoms having both petals and stamens fixed to the receptacle* just beneath the seed-vessel or vessels. Our next move was to plants which, still with many petals, had both petals and stamens attached, not to the receptacle, but to the calyx,* the rose tribe being the first examples. Another advance brought us to plants which, instead of having many-pieced corollas, had them all in one piece,† but still with the same attachment as the last named many-petaled, to the calyx; and now in our fourth step we find ourselves returning to the receptacle attachment as at first, only with monopetalous corollas. To make the above more clear, we subjoin the following table, which is a slight simplification of that prefixed to that best of British Floras, Hooker and Arnott's:—

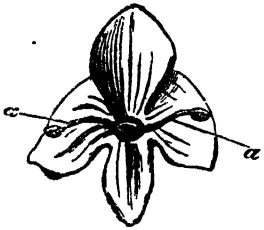


FIG. 63.—One-pieced deciduous corolla of Common Speedwell. *a, a*, The stamens attached to the corolla.

Corolla in Many Pieces	Corolla and stamens inserted on receptacle, represented by buttercups and poppies
	Corolla and stamens inserted upon calyx, represented by roses and pea tribes.
Corolla in One Piece	Corolla and stamens inserted upon calyx, represented by campanulas and composites.
	Corolla and stamens inserted on receptacle, represented by primrose and mint tribes.

A glance will now tell our traveller in Flora's realms the ground he has already gone over, and, as we find ourselves in the fourth or last division, we again return to our primroses and their congeners. We should tell you, however, that in this last division there is yet a sub-division into plants which have their stamens, like the heaths and plantain, free (Fig. 64), and that by far the largest portion, which have their stamens attached to the corolla,

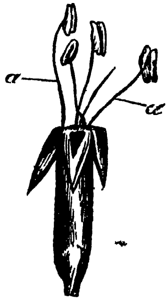


FIG. 64.—Floret of Common Plantain. *a a*, Elongated filaments of stamens.

No. 1.

* See Handful No 2. † See Handful No. 3.

consequently, through it to the receptacle. Take one of these little heath-bells (Fig. 64), open it up, and you will see the stamens are all connected directly with the receptacle. Now take your primrose flower (Fig. 65), and you will find the five stamens all inside the tube (Fig. 66), and so closely attached to it, that there is scarcely anything you can call a filament. The heath flower is a good example of what botanists

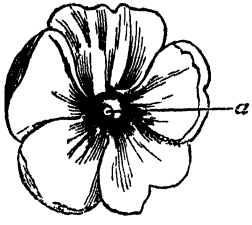


FIG 65.—Salver shaped blossom of Common Primrose a, Globular stigma showing at mouth of cylindrical tube.

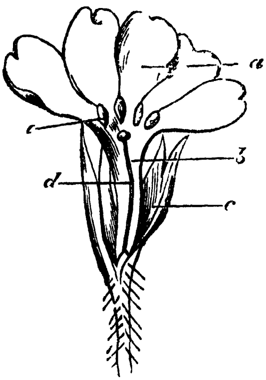


FIG 66.—Flower of Common Primrose laid open a, Limb of corolla, b, tube of corolla, c, calyx, d, pistil, e, stamens.

call the inflated corolla, as the primrose (Fig. 65) is of the salver-shaped, the flat expanded portion constituting the limb, which merges into the *tube* at the *throat* (Fig. 67). Compare the forget-me-not in your hand with these: it is somewhat like the primrose, but more *wheel-shaped;* the tube you will find is much shorter than that of the primrose or cowslip, and yet it includes the stamens, which are attached to it. Moreover, the little tube is partly closed over with *scale* or valves. There are many species of the forget-me-not—mouse-ear it is sometimes called—but we are now presuming that you have got the largest and handsomest—the water plant (Fig. 68), the true forget-me-not which the drowning troubadour cast ashore to the feet of his lady-love The forget-me-not, or *Myosotis* genus, as botanists call it, belongs to the *Borage* tribe, the members of which are remarkable for being more or less clothed with stiff, rigid hairs. The primrose, from which we

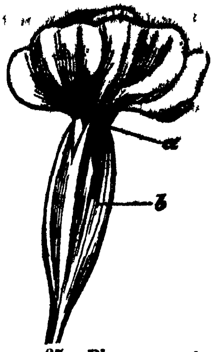


FIG. 67.—Blossom of Common Primrose a, Tube of corolla, b, tubular campanulate calyx.

FIG. 68.—Common Water Forget-me not. The corollas rotate, or wheel shaped

[illegible] to compare corollas with our little Myosotis friend, gives its own name to the tribe, the Primulaceæ, to which it belongs. More noted for the beauty than for the useful properties of its members, the tribe offers us most excellent examples of blossoms regular and perfect in every sense. First take a glance at the leaves of the primrose, as we shall refer to them shortly, and now take up the scarlet pimpernel (Fig. 53), and, if you know it, the yellow wood loosestrife (Fig. 69).

FIG. 69.—Spray of Common Yellow Loosestrife. *a a*, Solitary blossoms springing from the axils of the flower-leaves or bracts.

Both these plants are classed under the primulas. You, perhaps, do not think them *very* like, but just take the general description of the primrose family, as you find it in the Flora, remembering the general division into which we have already got our flowers; [illegible] one-piece l corollas, attached to the receptacle. The description says, "Stamens inserted upon the corolla, distinct"—that is, not connected one with another—"corolla coloured. Style terminal"—that is, springing from the top of the ovary—"ovary entire, one-celled; corolla regular; stamens opposite the lobes of the corolla, and as many, equal. Style 1." Such is a description which, taken along with the general classification, is sufficient to distinguish the primula family from any other family of British plants.

Consider it well, for it is a good lesson; the family is exceedingly distinct, and the characters given can be easily made out, even by a beginner. How the members of the primula family—the pimpernels, the loosestrifes, and the primroses themselves—are distinguished from each other, we must leave to our lesson on classification.

Our blue veronica, or speedwell (Fig. 63), itself a pretty little plant, has many relatives with more strongly-marked properties—among them the foxglove; moreover, most of its tribe have irregular corollas. You may at first have thought the veronica a regular flower, but a moment's inspection will show you it is not, and that two divisions of the corolla are larger than the other two. Indeed, the irregular blossoms of the figwort tribe, which includes our veronica, closely resemble those of our next tribe, the labiate plants, to which the dead-nettles, the mint, and the thyme, all of which you have in your Handful, belong.

The figworts and the labiates have, as you see, both of them irregular, two-lipped flowers; in other respects they are very different. Take one of your dead-nettles (Fig. 58), and examine it. First, there is a square stem; then there are opposite leaves, which hold clusters or verticilli of blossoms in their axils; the calyx has an upper and lower lip, and of the four stamens contained within the upper hood-like lobe of the corolla (Fig. 70), two are long and two short. Lastly, pull out this corolla, which comes away, stamens and all, and you will see, at the bottom of the tube-like calyx, what look like four little square seeds, which are really four little seed-vessels, each with its own single seed within. Go over again these characters of the labiates, and you cannot but see what strong family features they carry with them. Many, like the mints, thyme, marjoram, and lavender, are characterized by the abundance of their fragrant essential oils.

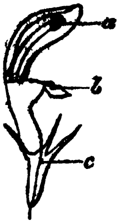


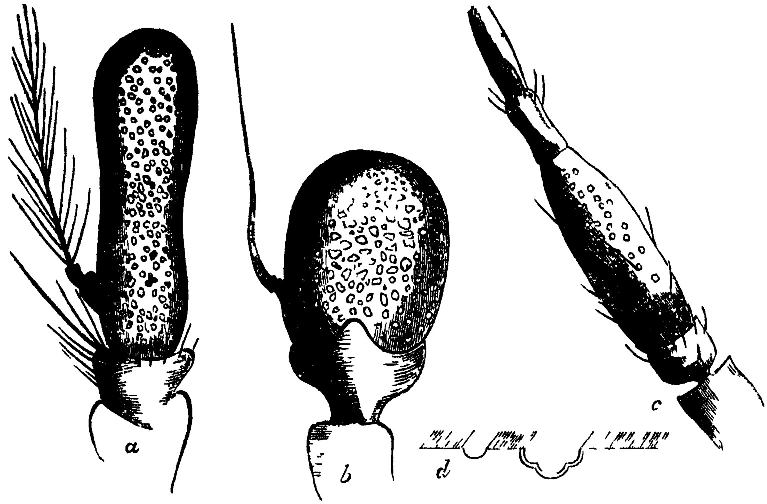
FIG. 70.—Floret of a Labiate plant. *a*, Stamens contained within upper or hood-like division of the corolla; *b*, lower lip of corolla; *c*, calyx, which is slightly irregular.

There yet remains for you to examine the holly, the convolvulus (Fig. 71), the sea-thrift, and the plantain. The convolvulus requires no lens to bring out its peculiarities, amid which the plaiting of the unexpanded corolla is conspicuous. As you advance in botanical knowledge, you will find the convolvulus tribe noted for many medicinal members, with which, possibly, you have made acquaintance under less agreeable circumstances; it is sufficient to name ipecacuanha and jalap as products of the Convolvulaceæ, to give you an interest in them replete with painful reminiscences, which may, however, aid to fix your lesson in your mind. We need not detain you with the thrift, further than to bid you examine it for characters similar to the rest of your Handful. Our spiked plantain is not so flower-like as the rest of its companions, that is to say, its blossoms want the size of some, and the bright colours of others of its associates; but each little floret of the spike is a perfect little flower, symmetrical and complete in every way, only it has a strange mode with its stamens, which have filaments so long that they require double folding (Fig. 64) in the unopened bud.

FIG. 71.—Common Bindweed or Convolvulus The corollas regular, in one piece or plaited; the leaves "hastate," or spear shaped.

Once more review your Handful, for it is an interesting and instructive one, seeking in each separate plant the general characters which bind its apparently diverse elements together.

SPENCER THOMSON, M.D.



a, Antennæ of Blow fly. *b*, Antennæ of Helophilus. *c*, Antennæ of Tipula.
d, Section of wall of Antennæ, showing the smaller and the larger chambers.

THE ANTENNÆ OF FLIES.

The last chapter, on the profiles of flies, will have shown the reasonable division of the Diptera into the two great groups, *Nemocera* and *Brachyura*, from the form aud length of their antennæ. Before we subdivide these groups into families and genera, it will be interesting to consider the use of these varied antennæ.

Naturalists are still uncertain whether they are organs of hearing or of smelling. Bondsdorf was amongst the first naturalists who advocated the opinion of the antennæ being the organs of hearing. Our own naturalist, Kirby, is satisfied that they are chiefly organs of hearing, but also used for touch and language, dividing them into *active* and *passive* antennæ; the active belonging to ants, bees, ichneumon-flies, and the Nemocera; the passive to the second group of the Diptera, which, from their size and position, cannot be organs of touch.

However this may be, there is no doubt that they are of vast importance to the insect, and the microscopical investigations of Messrs. Purkess and Hicks* have proved the existence of an immense number of cells in the antennæ of flies, bees, ichneumons, and dragon-flies, connected with the nervous system, and evidently the seat of delicate sensation.

The antennæ of the common blow-fly, or of the Helophilus, one of our commonest garden-flies, will astonish the examiner who cares to prove what Dr. Hicks has published respecting these organs.

Over the whole surface of the elongated third joint may be noticed at first sight a multitude of transparent dots, apparently vesicles; but, on closer examination, these are found to be cavities in the wall or crust

* "Transactions of Linnæan Society," November, 1856.

of the antennæ filled with fluid, closed in from the outer air by a very thin membrane, and each little sac connected with the nervous system by a distinct nerve.

There are no less than 17,000 of these organs on the surface of each antennæ in the common blow-fly. Besides these there are larger sacculated chambers dispersed here and there, about eighty on each side, and equally connected with the nervous ganglia.

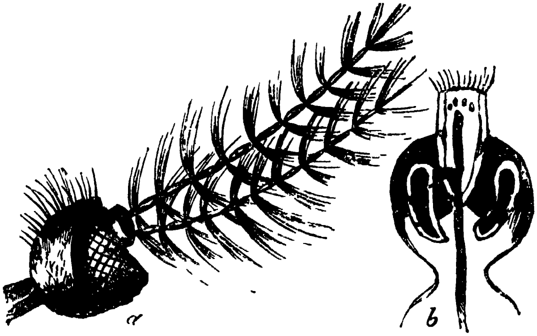
So important is the scarcely-noticed antennæ of a fly, and thus elaborately finished and fitted for the creature's use by its Creator.

In our garden-fly (*Helophilus*) the smaller cavities are not so numerous, but there are more of the larger ones; and hairs also arise from the interior of the cavity.

In *Tipula*, these organs are to be found in the third joint only.

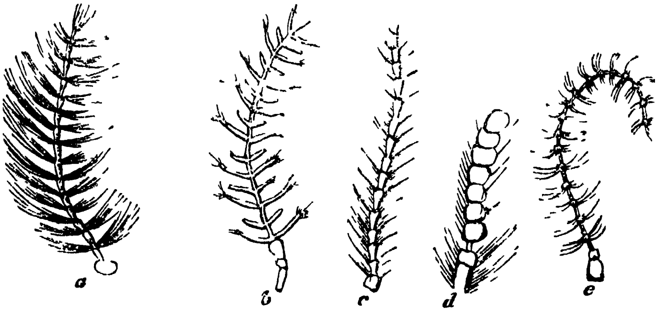
In *Bibio*, which has nine joints in its antennæ, the first two are free from these vesicles, but the last seven possess them.

It was Kirby's opinion that the bristles or setæ on the third joint of the antennæ, and also the plumose bristles of the *Nemocera*, were calculated for the action of electric and other fluids dispersed in the atmosphere, which, in certain states and proportions, may certainly indicate the approach of a tempest, or of showers, or a rainy season.



a, Head of Musquito. *b*, Section of Capsule.

And it is very remarkable that, when the atmosphere is in a highly electric state, and a storm coming on, even at mid-day, when the air is thronged with "winged creatures," they suddenly disappear—scarcely do we find a fly upon our flowers; and those who keep bees will all at once see a rush towards the hive, and the sensitive insects flying fast for shelter before a single drop of rain has fallen. It is well known that before rain the wicked little *Stomaxys calcitrans* is particularly irritating; and so are the forest-flies, tabani, and gnats.

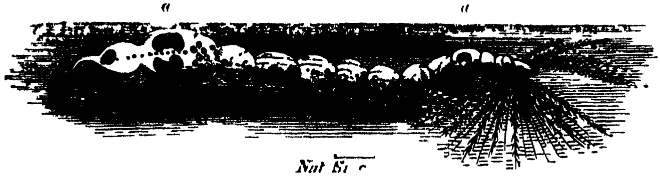


a, Antennæ of Corethra plumicornis (male). *b*, Antennæ of Ctenophora.
c, Antennæ of Rhyphus fenestralis. *d*, Antennæ of Bibio marci.
e, Antennæ of Cecidomyia.

There is another organ at the base of the antennæ of the male musquito or gnat, which is, doubtless, an auditory apparatus; it is a capsule, hollow within, containing fluid and minute corpuscules, with a nerve direct from the cerebral ganglion, and expanding through the capsule, probably enabling the insect to judge not only of the direction, but also of the distance and intensity of sound. The female gnat has not such large capsules, and is much more easily caught than the male.

Having so far explained the use of the antennæ, we must notice their varied form in each group, taking five of the commonest amongst the *Nemocera* as examples.

unless the eye is attracted by its sudden jerks, always turning from head to tail, then pausing awhile. Two pair of remarkably kidney-shaped bodies, *a a*, darker than the surrounding organs, are situated near the head, and at the third division of the body, the anterior



Larva of Corethra plumicornis *a a*, two pair of kidney shaped bodies supposed to be breathing organs. (De Geer, on piercing them, found that a considerable quantity of air escaped.)

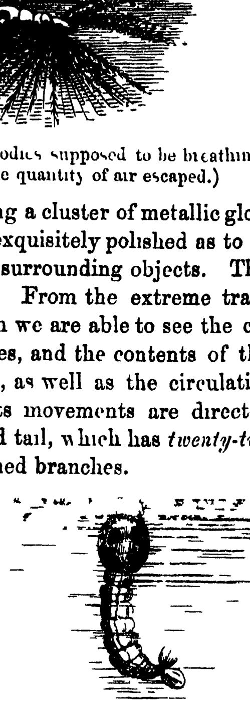
The *Cecidomayia* is the wheat-midge, which lays its eggs on the stamens of the wheat-blossom, and gives birth to the mischievous little larvæ which destroy the grain.

Bibio marci is a black, heavy fly, very abundant near London in the flower-gardens and in meadows, flying with their legs stretched out behind, the long anterior pair forming an acute angle with the body. Their larvæ feed on the roots of grass.

Rhyphus fenestralis is a common fly on our windows, feeds upon over-ripe fruit, and deposits its eggs in dung, from whence a long cylindrical worm comes forth, having a mouth furnished with two tentacular mandibles, and a tail with four short tubercles.

Ctenophæra.—One of the largest and handsomest of the *Nemocera*, yellow and black, with a brown spot on its wing, and has antennæ peculiar to itself. The larvæ feed in decayed wood and trunks of trees. More will be said of these flies hereafter.

The *Corethra plumicornis* is a very common species of gnat, especially near ponds and stagnant water; it has a most curious and beautiful larvæ, and its transformations are easily observed by covering a glass jar with a piece of gauze and confining a few of the larvæ. The body, as seen in water, is so transparent as to be frequently overlooked, pair having a cluster of metallic globules near them, so exquisitely polished as to reflect the forms of surrounding objects. Their use is unknown. From the extreme transparency of the skin we are able to see the crossing of the muscles, and the contents of the alimentary canal, as well as the circulation of the blood. Its movements are directed by the fan-shaped tail, which has *twenty-two* beautifully-plumed branches.



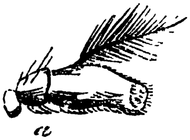
Pupa of Corethra plumic.

The transformation of this larva into the pupa state is exceedingly curious. Those kidney-shaped organs have partially disappeared, the upper ones have uncoiled and form a kind of half-circle, the lower ones have vanished, and the beautiful plumed tail changed into two finely-veined membranous lobes, whilst the head now bears two horns, inside which the Corethra's white-plumed antennæ are developing. There is no alimentary canal, for the pupa does not feed, and the motion of the body is entirely changed. The larva moved always horizontally; the pupa floats uprightly with its head near the surface of the water, waiting for the last change of the perfect insect into the light and life of a new existence.

A few examples from the Brachyura will enforce the necessity of observing the shape of the antennæ.

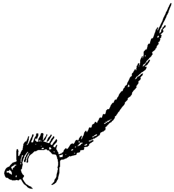
Supposing that our attention is drawn to a fly upon our window-pane, a glance at the antennæ with a pocket lens will often decide its family at once.

For instance an antennæ like *a* can belong only to a true Musca, or fly; one


a


b


c


d

like *b* as certainly belongs to an Empis; one like *c* to a Dolichopus; one like *d* to a Phora.

I give these examples because these flies are so frequent upon our window-panes that the reader may verify what I say without much trouble, and by examining the antennæ will naturally inquire if these are the only distinctive marks by which we learn to recognize the Diptera. By no means, they are equally dependent on the veining of the wings for the position they hold in natural order; but the wing of a fly is a large subject, and must be deferred to another chapter.*

L. Lane Clarke.

Woodeaton Rectory, Oxford.

METEOROLOGY OF SEPTEMBER.

FROM OBSERVATIONS AT HIGHFIELD HOUSE OBSERVATORY.

—o—

Year.	Mean Temperature of the Air. Degrees.	Mean Temperature of the Dew Point. Degrees.	Mean Pressure of the Air. Inches.	Mean Amount of Cloud. (0—10).	Number of Rainy Days.
1846	63·2	54·4	29·919	4·8	7
1847	53·6	47·0	29·846	5·9	15
1848	56·6	51·2	29·873	5·6	13
1849	55·3	50·9	29·799	7·5	13
1850	53·9	49·4	29·967	6·5	9
1851	54·5	48·1	30·032	6·3	9
1852	54·7	49·4	29·776	6·3	14
1853	53·5	47·6	29·825	7·5	9
1854	56·9	51·4	29·076	3·4	9
1855	56·2	50·2	29·970	5·7	6
1856	54·0	47·5	29·615	6·9	18
1857	58·4	52·9	29·759	6·6	16
1858	58·6	50·8	29·821	6·6	16
1859	55·2	49·4	29·656	6·7	20
Mean	56·0	50·0	29·845	6·2	12

The mean temperature of the last fourteen years for September is 56·0°, the range in the mean temperature being from 53·5° in 1853 to 63·2° in 1846, a difference of 9·7°. The lowest means occurred in 1847, 1850, 1853, and 1856, and the highest in 1846, 1857, and 1858. In 1846 the mean temperature was 4·6° higher than in 1858 (the next highest mean).

The mean temperature of the dew point of the last fourteen years for September is 50·0°, the range being from 47·0° in 1847 to 54·4° in 1846, a difference of 7·4°; the lowest means occurring in 1847, 1853, and 1856, and the highest in 1846 and 1857. The difference between the mean temperature and that of the dew point was as much as 8·8° in 1846, and 7·8° in 1858, and as little as 4·4° in 1849, and 4·5° in 1850.

The mean pressure of the last fourteen years, for September, at 174 feet above the sea, is 29·845 inches, ranging between 29·615 inches in 1856, and 30·032 in 1851, a difference of 0·417 of an inch. To reduce these readings to the sea level, it is requisite to add 0·185 of an inch, when the mean temperature is as low as 53·5° as in 1853, and 0·182 of an inch when it is as high as 63·2° as in 1846; thus the mean pressure. reduced to sea level, for the past fourteen years is 30·029 inches.

The mean amount of cloud of the last fourteen

* As these contributions to Recreative Science, are intended for practical use, it may be well to give directions for the preparation of the antennæ, that the reader who possesses a microscope may observe these characteristic organs. The antennæ being usually of dark colour must be bleached thus:—Put a few drops, say eight or ten, of hydrochloric acid into about half a drachm of chlorate of potash, and add half an ounce of water; it will effervesce, and then soak the antennæ therein for a day or two. This renders them transparent, and, mounting them afterwards in Canada balsam, the vesicles and the nerves will be distinctly seen with a quarter-inch object-glass.

years for September is 6·2, ranging between 8·4 in 1854, and 7·5 in 1849 and 1853, a difference of fourteenths of the whole sky.

The mean number of rainy days in the last fourteen years in September is 12, ranging between 6 in 1855, and 20 in 1859, a difference of 14 days. The years of but little rain are 1846, 1850, 1851, 1853, 1854 and 1855, and of much rain, 1847, 1856, 1857, 1858, and 1859.

E. J. Lowe.

ASTRONOMICAL OBSERVATIONS FOR SEPTEMBER, 1860.

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The Sun is in the constellation Virgo till the 22nd, and then in Libra. He is north of the equator while in Virgo, and south of the equator when he passes into Libra. He rises in London on the 1st at 5h. 14m., on the 10th at 5h. 29m., on the 20th at 5h. 45m., and on the 30th at 6h. 1m.; setting in London on the 1st at 6h. 44m., on the 10th at 6h. 24m, on the 20th at 6h. 1m., and on the 30th at 5h 38m. He rises in Dublin on the 9th one minute earlier, and sets two minutes later than in London; and on the 27th he rises and sets two minutes later than in London. At Edinburgh he rises on the 1st eight minutes earlier, and on the 22nd one minute later than in London; and sets on the 1st seven minutes later, and on the 23rd one minute earlier than in London.

The Sun reaches the meridian on the 1st at 11h. 59m. 44s.; on the 10th at 11h. 56m. 45s.; on the 20th at 11h. 53m. 15s.; and on the 30th at 11h. 49m. 51s.

The Equation of Time on the 1st is 0m. 16s.; on the 10th, 3m. 15s.; on the 20th, 6m. 45s.; and on the 30th 10m. 9s. after the Sun (subtractive).

Day breaks on the 12th at 3h. 32m.

Twilight ends on the 3rd at 8h. 45m., and on the 27th at 7h. 39m.

Length of day on the 10th, 12h. 55m.; and on the 24th, 12h. 1m.

The Moon is full on the 30th at 1h. 40m. a.m.

New Moon on the 15th at 6h. 9m. a.m.

The Moon is at her greatest distance from the earth on the 1st and 29th, and at her least distance on the 15th.

Mercury is in Leo at the beginning of the month, and in Virgo at the end of the month. He is favourably situated for observation at the beginning of the month in the morning. He is near α Leonis (Regulus) on the afternoon of the 6th, passes close to Saturn on the morning of the 7th, and is in superior conjunction with the sun on the 22nd, rising on the 3rd at 5h. 40m. a.m., on the 18th at 5h. 18m. a.m., and on the 28th at 6h. 29m. a.m.; setting on the 3rd at 6h. 19m. p.m., on the 18th at 6h. 12m. p.m., and on the 28th at 5h. 56m. p.m.

Venus is a brilliant object, and is a morning star. She is in Cancer, passing into Leo on the 30th. She is at her greatest western elongation on the 28th at noon, and is seen in the form of a half-moon of 28" in diameter; rising on the 3rd at 1h. 35m. a.m., on the 18th at 1h. 32m. a.m., and on the 28th at 1h. 41m. a.m.; setting on the 3rd at 4h. 35m. p.m., on the 18th at 4h. 20m. p.m., and on the 28th at 4h. 11m. p.m.

Mars, though brilliant, is somewhat decreasing in size, and is situated too low for favourable observation. He is in Sagittarius, and then in Capricornus, being in perihelion on the 16th; rising on the 3rd at 5h. 14m. p.m., on the 18th at 4h. 23m. p.m., and on the 28th at 3h. 50m. p.m.; setting on the 3rd at 12h. 13m. a.m., on the 18th at 11h. 41m. p.m., and on the 28th at 11h. 28m. p.m.

Jupiter is a brilliant object in the morning, although less bright than Venus. He is in Leo throughout the month, and is little more than 2° distant from Venus at 2 a.m. on the 29th; rising on the 3rd at 2h. 42m. a.m., on the 18th at 2h. 1m a.m., and on the 28th at 1h. 31m. a.m.; setting on the 3rd at 5h. 53m. p.m., on the 18th at 5h. 0m. p.m., and on the 28th at 4h. 26m. p.m.

Saturn is in Leo, and is visible in the morning at the close of the month; rising on the 3rd at 4h. 15m. a.m., on the 18th at 3h. 26m., and on the 28th at 2h. 54m. a.m.; setting on the 3rd at 6h. 32m. p.m., on the 18th at 5h. 37m. p.m., and on the 28th at 4h. 59m. p.m.

Uranus is an evening star in Taurus, rising on the 3rd at 9h. 41m. p.m., on the 18th at 8h. 42m. p.m., and on the 28th at 8h. 3m. p.m.; setting on the 3rd at 1h. 59m. p.m., on the 18th at 1h. 0m. p.m., and on the 28th at 12h. 21m. p.m.

Eclipses of Jupiter's Moons.—On the 27th, at 2h. 44m. 8s. a.m., the 2nd moon disappears; on the 28th, at 4h. 6m. 11s. a.m., the 3rd moon reappears.

Occultations of Stars by the Moon.—On the 6th, Merope (5th magnitude) disappears at 11h. 10m. p.m., and reappears at 12h. 12m. a.m.; Alcyone (3rd magnitude) disappears at 11h. 48m. p.m., and reappears at 12h. 49m. a.m.; on the 7th, Atlas (4th magnitude) disappears at 12h. 32m. a.m., and reappears at 1h. 37m. a.m.; Pleione (5½ magnitude) disappears at 12h. 34m. a.m., and reappears at 1h. 42m. a.m.; on the 29th, λ Piscium (5th magnitude) disappears at 1h. 28m. a.m., and reappears at 1h. 49m. a.m.

The variable star Algol attains its least light in the evening, on the 2nd, at 9h. 47m., on the 22nd at 11h. 26m., and on the 25th at 8h. 15m. p.m. Mira Ceti reaches its maximum on the 6th; its period is more than eleven months, of which it is invisible to the naked eye for seven. Its variations are irregular, continuing at its greatest brilliancy a fortnight, sometimes as a 2nd magnitude star, and at others as a 4th magnitude star.

Stars on the Meridian.—On the 6th, α Aquilæ, at 8h. 39m. 24s. p.m.; on the 10th, α Lyræ, at 7h. 12m. 6s. p.m.; on the 13th, δ Aquilæ, at 7h. 46m. 26s. p.m.; on the 15th, α Cygni, at 8h. 56m. 34s. p.m.; on the

19th, α Pegasi, at 11h. 1m. 36s. p.m.; on the 24th, Fomalhaut, at 10h. 34m. 6s. p.m.

On the 30th the length of day has decreased 4h. 16m. E. J. LOWE.

THE MICROSCOPIC OBSERVER. SEPTEMBER.

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ACHLYA.—The fresh-water aquarium will usually furnish examples of Achlya as the season declines, and the stone loach is most subject to it of any of the fishes kept in tanks. The gold carp is frequently affected, and indeed fresh-water fishes generally in a state of confinement during chilly weather. It usually appears first about the gills in the form of filamentous and colourless bundles, gelatinous to the touch, and as it spreads it forms cloudy masses, which impede the motion of the fishes affected with it, and in time ramify within the gill-plates and over the base of the dorsal fin, the victim of the parasitic growth meanwhile becoming more and more sickly and feeble, and at last perishing at the bottom of the vessel. This parasite is an interesting subject for microscopic study. That it is closely related to the Fungi will appear from the most cursory examination, as well as from its mode of growth. In the "Micrographic Dictionary" it is referred to the Algæ, but by many authors it is regarded as a veritable fungus, entitled to a distinct position; others consider it an aquatic form of *Botrytis bassiana*, or of *Empusa muscæ* (Cohn). It should be examined while in a perfectly fresh state, and if a sample is not readily obtainable, it can be produced by throwing a few dead blue-bottles into a vessel of water, which, if left uncovered for a few days, will be found clothed with the gelatinous filaments. It will be found that the filaments rise from a mycelium, which holds tenaciously to the object on which the plant has grown, and it is the mycelium, doubtless, which renders it destructive to fish by its action on the cutis. The filaments at the outsides of the bundles are the best for individual examination. They contain a colourless protoplasm, the granules of which exhibit a slow motion analogous to other well-known instances of the circulation of cell contents. The cell contents give a yellowish brown colour when acted on by iodine, and the walls of the tubes are coloured blue by iodine. But there is no trace of starch. The formation of zoospores will be the subject of chief interest to the student. These result from an accumulation of protoplasm at the upper part of the tube, which first becomes slightly brownish, and then acquires a clubbed form. "A sharp line of demarcation is soon formed by the division of the primordial utricle, followed by the production of a septum, which shuts off this clavate joint as the sporange; and a little projecting pouch or beak is developed at the summit, or sometimes a little below this on one side." The phenomena, which terminate in the formation of primordial utricles and the subsequent ejection of daughter cells, merit the closest attention, and will well repay the careful observer. The attachment of these daughter cells in a cluster upon the summit of the empty sporange continues for about four hours in dull weather, but for only two hours if the weather be warm; they then emit their contents, and, as the zoospores increase in size, the two cilia with which each is furnished come into action, and after finding a nidus for them, the zoospores take up their positions, and germinate at once. During the observation the specimens must be in sufficient water, and not too much pressed, and when the successive phenomena have been observed frequently, the observation may be varied by using more pressure and less water, which will prevent the emission of zoospores, and cause their germination within their cell membranes.

SMUTS AND MILDEWS.—In a damp and cold season like the present, the harvest-fields present numerous objects for the microscope, in the various forms of fungi classed in the order *Coniomycetes*, the spread of which may go so far as to convert plenty into famine, and even when not affecting seriously the aggregate of the produce, always more or less affect the quality of the grain. The systematic study of these forms dates from 1824, when Sir Joseph Banks submitted to Bauer samples of wheat seriously affected with "blight," and the result was a series of drawings, exquisitely executed, of the fungi concerned in the damage of the crop. A good preliminary to the study of this order of fungi is an investigation into the nature of the stomates on a wheat-straw. The outer envelope of a straw will be found to be marked with longitudinal stripes, the one imperforate, and the other furnished with stomates or pores. In damp weather these stomates are open, and on Bauer's theory the spores of the fungi gain admission by means of them, and germinate in the hollow beneath, where they intercept the sap, destroy the tissues by the ramification of their mycelium, and render the grain deficient in its proper farinaceous products. Still further to illustrate the structure of stomates, take a leaf of common *Hypericum*, and place a fragment, underside uppermost, on a slip of glass, and with a half-inch object glass and the speculum, trace them out in damp and dry samples for comparison. The *Coniomycetæ* are mostly parasitical, the mycelium is filamentous, and the fructification is by stalked or sessile spores. In the lowest forms the mycelium itself gives rise to spores; in others higher in the series, definite hollow conceptacles are formed generally on the surface of the epidermis of the plant infested, the mycelium being under the epidermis; in others the conceptacles are formed beneath the epidermis, and break through it to disseminate their spores. The order is not firmly established, and Bauer's views as to the entrance of the spores by means of the stomates is not well borne out by observation, except in the case of *Puccinia graminis*, and perhaps a few other species of the same genera. The families recognized in this order are:—1. Sphæronemei; 2. Melanconiei; 3. Phragmotrichaceæ; 4. Torulacei; 5. Urodinei; 6. Ustilaginei. Of these the fifth is very unsatisfactory, and the others by no means sufficiently definite to meet the requirements of modern classicology. The most common examples just now are *Puccinia*, which are grouped under *Uredinei*. The species are numerous, and commonly distributed on corn-grasses, reeds, and herbaceous plants. *P. graminis* is just now in its maturity, and where it is rampant the cuticle is irregularly spotted with longitudinal marks of a dark colour, which indicate the approaching rupture of the cuticle and the dissemination of the spores. Fries calculated that the spores are produced by millions from individual plants, and says when set free they rise like thin smoke in the air. To observe the *Puccinia* strip off lengthwise a small portion of the straw, and view it as an opaque object with a half-inch object-glass and a low power. It will appear studded with stalked fruits of an oblong or pear-shaped form, crowded together in patches. Amongst them will be found intermixed spores of *Uredo*, which are globular and of a reddish colour. To trace out the individual structure of the fructification, scrape off a portion of cuticle so as to obtain a transparent object, and view this with a higher power. With light passing through it, the stomata will be seen to be occupied by the pest, the mycelium of which rests in the cavity beneath. A still further study must be made by separating a portion of the true *Puccinium* by means of a needle · moisten the specimen, place it between slips of glass, and view as a transparent object, when the structure will be revealed. The spores of this species germinate without becoming detached from the matrix. Samples of wheat-ears, blackened with a sooty dust, are not to be taken as exemplifying the production of *Puccinia*. The fungus which causes the black mildew on the ears is *Cladosporium herbaurm*, which produces terminal spores on pointed branches. This is one of the most abundantly diffused moulds, and differs from *Puccinium* in, among other things, being produced only on vegetable substances already in a state of disease or decay from previous causes. *Cladosporum herbarum* forms a web of microscopic filaments, from which arise chains of spores which separate and disperse, and germinate on plants that have declined in vigour through the ordinary progress of events, or through disease induced by unsuitable soil or ungenial weather. *C. dendriticum* may be sought now on leaves of pear and hawthorn; *C. depressum* on leaves of the angelica; and *C. lignicolum* on dead wood. The other species, *brachormium* and *nodulosum* it is late in the season for. In the search for *Puccinia*, many species of *Uredo* may be met with. Early in the spring *Uredines* are found on the tender corn-blades, and when plentiful it gives a yellow tinge to the herbage. At the present time the harvest fields present many examples of its spread among ears of corn; whole fields in some places, where drainage is deficient and the soil in a rank damp condition, being tinted with its ominous rust-red. The specimens are to be gathered and examined in the same way as directed for *Puccinia*, except that the sample must be obtained from the grain and husk. *U. linearis* has oblong spores, *U. rubigo*, spherical; the last-named is the veritable red-rust. Among the leaves of roses, at this season, spots of ochreous rust may often be found. Géant des Batailles and Ravel are very subject to it, and, as a rule, crimson-stemmed roses are most prolific in vegetable parasites of all the members of the family. The rust on rose-leaves is caused by *U. rosæ*. *U. rubrorum* is met with on leaves of the bramble. *U. segetum*, which occurs chiefly on barley, is now past its season, but samples may nevertheless be found of its diffused black spores by looking for the blighted skeleton-looking ears on which it has made its ravages. In the summer the blossom of the wheat is often attacked by it, and the ears that follow rarely attain the thickness of a quill, and have a dark appearance.

Objects worth Seeking.—For observation of pollen cells, and the structure of ovaries, blossoms may now be obtained of crocus sativas, ivy, aralia spinosa, autumnal snowflake, meadow saffron, arbutus, senecio luridus, golden-rod. The field-cricket and house-cricket for the tympanum of the elytra; death's-head hawk moth for the palpi and spiral tongue, which, according to Reaumur, are the organs which produce the ominous noise. The libellula afford exquisitely-beautiful examples of wing membrane and nervation; the manducating mouth contrasts strongly with the mouths of suctorial insects. The 16-spotted coccinella, now to be found in most gardens, is a useful object to exhibit the circulation through the elytra. The wing case must not be detached, but be carefully viewed as a transparent object, when currents will be seen between the laminæ.

Mr. Noteworthy's Corner.

Private Observatories.—In the opening address, delivered before the British Association, the noble president laid stress on the assistance rendered to astronomy and mete ology by private observatories He said, they "occupy that portion of the great astronomical field which is untilled by the professional observer; roving over it according to their own free will and pleasure, and cultivating with industrious hand such plans as the more continuous and severe labours of the public astronomer leave no time or opportunity to bring to maturity." Let these words encourage those who possess observatories to continue their agreeable labours with diligence, and stimulate many, who take delight in practically testing acknowledged principles and adding to the stock of facts for the establishment of principles as yet unsettled, to set up observatories of their own, and increase the ties of fellowship among the individual explorers of the atmosphere and the heavens.

Interesting Experiment for the Microscope.—The embryo grain of wheat, at the time of blossoming being carefully taken out of the husk, will be found to have a small downy tuft at its extremity, which, when viewed in a microscope, greatly resembles the branches of thorn, spreading archwise, in opposite direction By expanding a few of the grains, and selecting the most perfect, a very pretty microscopic object will be obtained for preservation.—W. N. R. B.

The Himalaya Snow Partridge.

THE SNOW-PARTRIDGES OF THE ASIATIC MOUNTAINS.

One of the principal objects aimed at by Sir Stamford Raffles, Sir Humphry Davy, Lord Derby, Mr. Vigors, Mr. Bennett, and other scientific gentlemen, who united in the formation and establishment of the Zoological Society, was the naturalization of useful exotic animals; and many trials were made, especially on a breeding farm at Kingston; but the success was not equivalent to the necessary expenditure, and ultimately the farm was judiciously abandoned. In the meantime, and long subsequently, the Earl of Derby maintained a splendid establishment at Knowsley, to the success of which allusion has been made in a paper on the Eland, at page 224 of the first volume of this work.

Whatever foreign animals may be added to our domestic list, their naturalization will be owing, as it has been, to the tact and exertions of private individuals; and it is, perhaps, for the best that such should be the case. Every man takes an especial interest in the success of his own labours, and pursues the plan which he deems the most advisable, unchecked by interference. It is true that on the Continent, especially in France, Government has, at various times, greatly promoted the naturalization of foreign animals, or the transference of valuable breeds from adjacent countries. We may instance the merino sheep from Spain, and the shawl goats from Asia. Moreover, the labours of scientific and practical writers on the *res rustica* have always been received with encouragement. Nor has this unobtrusive work been neglected in other countries. It would seem (at least, great is the probability) that we owe the first introduction of the turkey into Europe to Spain; and the Guinea-fowl, now a common denison of our farm-yards, has long been a wild bird in Hayti and other West Indian islands, introduced by the importers of negro slaves.

In Holland, several species of curassow have been domesticated and reconciled to an European climate; and, as M. Temminck informs us, bred abundantly in the menagerie of M. Ameshoff, prior to the great French Revolution which shook the Continent. The curassows and guans, originally from Mexico, are equal to the turkey in stature and goodness of flesh. They have bred in England, but have been strangely neglected.

Greatly are we here tempted to give a table (which we have prepared with some degree of care) of the animals (quadrupeds, birds, reptiles, and insects) which man has either completely reclaimed, or taken under his supervision and protection. The schedule is extensive, and would require many comments; yet, as our paper relates to certain birds, perhaps an extract from the ornithological portion of our list may be not unacceptable.

Let us premise that, according to our present view of the subject, birds arrange themselves under the following heads:—1. Such as are truly domesticated; 2. Such as offer to us individuals only, reclaimed and trained, captives, not free tenants of the precincts of the homestead (albeit their wild parentage is not extinct); 3. Such as we superintend, in a half-reclaimed state, and place under the protection of the laws.

I. Truly Domesticated.

1. The [illegible]on *Fowl.*—Varieties numerous. [illegible] from one source? Origin, the fowls of India.
2. The *Turkey.*—Three species known; one only domesticated in Europe. North meridional America.
3. The *Peafowl.*—Two species; one only common. India, the Indian Islands, Burman Empire, Malaya generally.
4. *Guinea-fowl.*—Several species; one only common in Europe. Africa.
5. *Pigeon.*—Varieties numerous; origin, *Columba livia*, or rock-dove (not stock-dove). Europe, Asia, Africa. Query, may there not be an intermixture of species here? Many things militate against this idea: great is the influence of domestication through thousands of years.
6. *Curassows* and *Guans.*—Several species; many of which have been domesticated. They are ordinary tenants of the poultry-yard in Mexico—so, at least, we have been informed.
7. *Common Goose* (*Anser palustris*).—Origin, greylag wild goose. Europe.
8. *Egyptian Goose* (*Chenalopex Ægyptiacus*).—Not often seen domesticated in Europe, but was formerly common as a domestic bird in Egypt. Its beauty renders it an ornament on sheets of water in parks; it breeds freely.
9. The *Canada Goose.*—The ordinary tame goose of North America. Origin, *Anser Canadensis.* Not very uncommon as a domestic bird in our island.
10. The *Swan Goose,* or Chinese goose (*Anser cygnoides*).—By no means uncommon in our farm-yards; an elegant bird, with a swan-like contour. It is common in India and China, and hybrids between this and the common goose are largely bred, vast flocks being kept for profit. These hybrids will breed (*but not freely*) with the pure stock, on either side. We are assured, however, that in India the hybrids will propagate *inter se.* This remains to be proved. We doubt it.

11. The *Cereopsis Goose.*—From Australia. A most valuable bird, domesticated on the estates of several landed proprietors; at the same time, it cannot be said to be an ordinary denison of the poultry-yard.
12. The *Common Duck* (*Anas boschas*).—Several varieties. Wild origin. Spread through Europe, Asia, and North America.
13. The *Musk Duck.*—So called from its scent (*Anas moschata*). A valuable bird, common in farm-yards, wild in meridional America.

II. Reclaimed Individuals, not breeding in captivity.

1. *Falcons and Hawks*, of various species, captured when young, and trained for the purpose of falconry.
2. *Cormorants.*—Once used commonly as trained fishing-birds in Europe, including our island, when they were "manned" like hawks. Charles I. had his master of cormorants. In China, cormorants are commonly employed in fisheries.

III. Birds Naturalized, but which cannot be called tame, being under supervision only.

1. The *Pheasant.*—Three species of this lovely bird intermix in our preserves —all are from Asia, and perhaps one from the Eastern limits of Europe. The Colchican pheasant was known to the Greeks and Romans.
2. The *Ordinary Tame Swan* (*Cygnus olor*). —From the great lakes of Asia.
3. The *Polish Swan* (*Cygnus immutabilis*, Yarrell).—A native of the Baltic; it occasionally visits our island, and has been bred on our lakes and sheets of water under the same circumstances as the *Cygnus olor*.

Several other species of swan, as the *Cygnus ferus* and black-necked swan of South America, as well as the black swan of Australia, are kept as ornaments in parks, etc. So also are the teal, the Chinese teal, the American teal, the sheldrake, and others; but we cannot class them among truly-domesticated birds.

With respect to caged birds, and especially the canary, we cannot call them domesticated. The canary is, indeed, so far acclimatized, as to endure our temperature under careful treatment, and the same observation applies to certain Australian parrakeets and other species which breed; but these come not under any of the foregoing heads. The same observation applies to the ostrich, the cassowary, the emeu, and the rhea, which have bred in confinement under judicious management. We cannot fairly place them within the limits of our domesticated birds.

It will be evident to our reader, in perusing the list, which we have contracted within as narrow limits as possible, that the birds most intrinsically valuable to us belong first to the gallinaceous or rasorial order; secondly, to the columbine or gyratorial order (formerly united to the gallinaceous, but now rightly separated from them on grounds which we cannot here enter upon) and the natatorial order. But, all things taken into impartial consideration, the value of our gallinaceous birds, to which belong not only the pheasant but the partridge, the capercailzie, the blackcock, the red-grouse, the ptarmigan, and the quail, is, as the chemist would say, in excess. To this group belong the common fowl, peafowl, turkey, curassow, Guinea-fowl, familiar, if we except the curassows and guans, to every one. Truly a good list; but as a few new quadrupeds (mammals) are desirable by way of additions to our stock of cattle, sheep, goats, and deer, so would a new and most valuable addition to our gallinaceous list be received with satisfaction. Let us, then, introduce to our readers a genus of birds, called Snow Partridges (*Tetraogallus*), partaking of the characters of the grouse and the partridge, with perhaps a leaning towards some of the Himalaya pheasants, as the gorgeous impeyan and others.

We speak from knowledge when we say that one species has been tested in our country, so that no doubt remains as to the facility of its establishment. A mounted specimen of the bird (female) is now before us, the present of our great ornithologist, Mr. Gould, whose works are monuments of scientific acumen, artistic beauty, and fidelity.

As to the difficulty of procuring these noble birds, that has been and may be overcome, without either great expense or exertion. But why delay our main subject?

Know, then, that in the mountain regions of Asia, regions where the storm-king holds his court, there exists a race of large gallinaceous birds, equalling a turkey-poult in size, and of which several species are known to travellers and naturalists. These mountain birds are termed, as we have said, Snow Partridges.

The first to be noticed is the Caspian Snow Partridge (*Tetraogallus Caspius*). This noble bird, of which a few specimens (but unfortunately not male and female together) have lived for several years in the menagerie of the Zoological Society, is spread throughout the wild mountain regions of Persia, and probably extends its *habitat* into the confines of Europe, having been seen, according to report, among the peaks in the island of Candia. It is abundant throughout the Caucasian range, rearing its brood amidst the snow-clad rocks, and is at once active, alert, and wary, rising with a loud cry on the slightest appearance of danger; so that, unless shrouded in the obscurity of mist, the most skilful sportsman fails in his attempt to approach within range of gunshot. It associates in coveys, varying from six to ten individuals in number, and grows very fat in autumn, probably from the abundance of mountain berries which offer themselves as food. It is the inseparable companion of the ibex, or wild goat, on the dung of which, consisting of semi-digested vegetable matter, it feeds during the rigorous season of winter.

Mr. Layard ("Discoveries in the Ruins of Nineveh and Babylon") expressly notices a kind of partridge, identical, we doubt not, with the present species. "A covey of large birds," he says, "sailed by with a rapid swoop, and with the whistling sound peculiar to the partridge tribe, from an opposite height, and alighted within a few yards of me. They were the *Kabk-i-dered*, or *Our-kak-lik*, as they are called by the Turks—a gigantic partridge, almost the size of a small turkey—only found in the highest regions of Armenia and Kurdistan." We may here observe that in the Tiyari range (Kurdistan), a smaller species of mountain partridge, or bartavelle, *Perdix sinoïca* (intermediate between *P. græca* and *P. chukar*), is very abundant, and numbers are kept in a domestic state. "Almost every youth in the country (Asheetha) carries one of these birds at his back, in a round wicker cage; indeed, while the mountains and the valleys swarm with wild partridges, the houses are as much infested by the tame."—("Nineveh and its Remains," vol. i. p. 178.) Surely this bartavelle partridge might easily be introduced into the mountain districts of the northern counties of our island.

It is, however, with the Great Snow Partridge that we are here more immediately concerned. This bird is the *Keph-e-derra* or Royal Partridge of Persia, where trained hawks of a high caste are used in its pursuit, as well as in that of a fine species of bustard These hawks assist the greyhounds in pulling down the antelope.

With respect to these snow partridges Mr. Gould observes that as the great plateau of Asia (particularly the country of Thibet) is yearly becoming more and more accessible the time cannot be far distant when the introduction of some of the species into the British Islands will be attended with success. "I cannot conceive of localities better adapted to the habits of any of them than the Highlands of Scotland, and the hilly districts of Northumberland, and other northern counties of England." He then refers to the individuals, which, of course, under many disadvantages, have lived so long in the gardens of the Zoological Society, and which when first introduced were sickly and in a bad state of plumage, but which speedily recovered; exhibiting, after moult, an appearance as beautiful and healthy as they would have done in their native wilds. The individuals in question were obtained in Persia—one presented by R. Stevens, Esq., H.B.M. Consul at Tabriz, the other by E. W. Bonham, Esq.

We subjoin the colouring of the present species, which differs chiefly from the others in the arrangement of markings, of value chiefly to the professional ornithologist:—

Crown of the head, the neck, and upper surface generally slaty brown, minutely freckled with a darker tint; chest (male) nearly uniform blue and gray, variegated in the female with zigzag markings of buff and brown; shoulders slaty brown freckled with black; primaries and secondaries white, largely tipped with blackish brown; tail dark brown, freckled with black, and tipped with brownish red; cheeks and sides of the neck white—under surface grayish buff, with streaks of reddish brown—the white cheeks and sides of the neck separated from the buff by a broad stripe of brown freckled with black; a brownish streak over each eye; irides hazel; bill horn-colour; legs and feet orange yellow. This, with specific variations, is the normal style of colouring throughout the group. The limbs are stout.

A still more magnificent species is the Himalayan snow partridge (*Tetraogallus Himalayensis*), the *Kubuk-deri* of the natives of Cashmere.

The Himalayan range is the *dilecta sedes* of this noble bird, where it seems to be most abundant on the southern slope, extending its range throughout Thibet. Mr. Vigne, who observed it in Cashmere, states that, in the Himalayas behind Simla, it tenants the snowy *panjabs* on both sides of the valley, but is still more common in the Thibets. "I had," he says, "several of them alive, and am confident that they might be brought down the Indus," *en route* for England, "as they thrived well so long as I looked after them myself." It is this species more particularly which Mr. Gould hopes and expects to see naturalized in Europe. "It is the one most easily obtainable, and might be sent without much trouble or expense, either to the transmitter or to the receiver."

"These fine birds," says Captain Hutton, "are common in the Huzzarah mountains, and other high ranges. They are called *Kowk-durra, i.e.*, Partridge of the Ghâts, or passes. Sometimes they are sold in the markets of Cabool. I possessed four living birds at Candahar, which were kept, with wings cut, in a large courtyard, and lived well for many months. I gave them to a friend, Captain M'Lean, of the 67th Regiment, who wished to take them home to the Highlands of Scotland; but he unfortunately died on his way back to India, and I know not what became of the birds. They are common in the snowy passes of the Himalaya, and in Tartary. They rise in coveys of from ten to twenty, and usually have a sentry perched high on some neighbouring rock, to give warning of danger by his loud and musical whistle. They are difficult birds to shoot, and I usually found them in patches of the so-called Tartaric furze." The weight of this species is about six pounds. The eggs are of the size of the domestic turkey, but, like those of the grouse, are more lengthened in form; the ground colour is clear olive, sparingly dotted over with small pale chesnut spots. Specimens are contained in the British Museum, and in the collection of H. F. Walter, Esq.

The Himalayan snow partridge is strong

on the wing, and capable of sustaining a protracted flight. It may readily be distinguished from its congeners by the conspicuous chestnut streaks on the sides of the neck, by the black and white scale-like feathers of the chest, and by the dark slate-colour of its under surface. Legs and feet red.

It is of this species that we give a figure, copied, by permission, from Mr. Gould's grand work on the "Birds of Asia."

Mr. Gould figures and describes two other species, viz., the Thibetan snow partridge (*Tetraogallus Thibetanus*, Gould), and the Altaic snow partridge (*Tetraogallus Altaicus*, G. R. Gray).

Of the former Mr. Gould says: "This is entirely a new species, and the smallest member of the genus yet discovered. Examples have been transmitted to the Hon. East India Company—one from Ladakh, by Captain Strachey; the other by Mr. Hodgson, *via* Nepaul. In all probability it will prove to be an eastern representative of the Altaic and Caspian species, along the elevated ranges on the borders of China; but at present we know nothing of its habits, or the extent of its distribution."

With regard to the Altaic snow partridge, Mr. Gebler says, that it inhabits this mountain range generally; but is most abundant near the sources of the river Argut. Its food consists of the buds and young shoots of alpine plants, together with seeds and insects. A conical pointed spur is found on the tarsi of the old male. Weight, six Russian pounds. Several examples, obtained by way of St. Petersburg, from the Russian possessions in the Altaic mountains, grace the Museum of Paris, the British Museum, and the collection of H. E. Strickland, Esq.—(See *Perdix Altaica*, in "Bull. de l'Acad. Imp. de St. Petersburg," tom. i. and vi.)

It is more than probable that other species will be added to this interesting and important group—of which, so far as naturalization in the mountains of our island is concerned, are the Caspian and the Himalayan snow partridges—more particularly the latter. But why not both? As to the importance of the acquisition of these birds, little need be said, nor need we insist upon the almost certainty of their naturalization in the Highlands of Scotland, where the capercailzie (formerly a denison of the mountain forests) has been reintroduced (the race having been extirpated), and is now multiplying, under protection, in the pine forests of some of the Scottish nobles. The snow partridges are not forest birds; but the mountain peaks, the gorges, and wild glens will afford them a *habitat* as congenial as those of Persia, or of the Himalayan range. We hope that the day of their introduction is not far distant.

W. C. L. MARTIN.

THE STRUCTURE AND MOVEMENTS OF COMETS.

REMARKABLE COMETS.

WE shall proceed, in the present paper, to describe a few of the most celebrated comets on record, commencing with the comet of 1858 (vi.) On June 2, 1858, Dr. G. B. Donati, at Florence, descried a faint nebulosity slowly advancing towards the north, and near the star λ Leonis. Owing to its immense distance from the earth (240,000,000 miles) great difficulty was experienced in laying down its orbit. By the middle of August, however, its future course, and great increase of brightness in September and October, had been ascertained with

FIG. 1.—Comet vi., 1858, on Aug. 28. (Telescopic view.)

entire certainty. Up to this time (middle of August) it had remained a faint object, not discernible by the unaided eye. It was distinguished from ordinary telescopic comets only by the extreme slowness of its motion (in singular contrast with its subsequent career), and by the vivid light of its nucleus: "the latter peculiarity was of itself prophetic of a splendid destiny." Traces of a tail were noticed on August 20, and on August 29 it was faintly perceptible to the naked eye; for a few weeks it occupied a northern position in the heavens, and was thus seen both in the morning and evening sky. On September 5 the head presented the appearance shown in the accompanying sketch. On September 6 a slight curvature of the tail was noticed, which subsequently became one of its most interesting features. On September 17, the head equalled in brightness a star of magnitude 2, the length of the tail being 4°. The comet passed through the perihelion on September 29, and was at its least distance from the earth on October 10. Its rapid passage to the southern hemisphere rendered it invisible in Europe after the end of October, but it was followed at the Cape of Good Hope for some months afterwards, and was last seen by Sir T. Maclear at the latter place on March 4, 1859.

FIG. 2.—Comet VI., 1858, on Sept. 5. (Telescopic view.)

When these observations are fully discussed, we may expect to get a much more certain determination of the comet's periodic time than we at present possess.

"Its early discovery enabled astronomers, while it was yet scarcely distinguishable even with the telescope, to predict, some months in advance, the more prominent particulars of its approaching apparition, which was thus observed with all the advantage of previous preparation and anticipation. The perihelion passage occurred at the most favourable moment for presenting the comet to good advantage. When nearest the earth, the direction of the tail was nearly perpendicular to the line of vision, so that its proportions were seen without foreshortening. Its situation in the latter part of its course afforded also a fair sight of the curvature of the train, which seems to have been exhibited with unusual distinctness, contributing greatly to the impressive effect of a full length view." This comet, although surpassed by many others in size, has not often been equalled in the intense brilliancy of the nucleus, which the absence of the moon, in the early part of October, permitted to be seen to the very best advantage. There is no doubt but that the comet of Donati revolves in an elliptic orbit; the period, however, is at present somewhat uncertain, but is probably about 2500 years.

FIG. 3.—Comet VI., 1858, on Oct. 10.—(G. P. Bond.)

The following is a table of the dimensions of the comet's nucleus and tail at the under-mentioned dates:—

Date. 1858.	Diam. nucleus. " miles.	Length of tail. ° miles.
July 19 ...	5 = 5600	...
Aug. 30 ...	6 = 4660	2 = 14,000,000
Sept. 8 ...	3 = 1980	4 = 16,000,000
„ 12 ...	...	6 = 19,000,000
„ 23 ...	3 = 1280	5 = 12,000,000
„ 25 ...	...	11 = 17,000,000
„ 27 ...	...	13 = 18,000,000
„ 28 ...	...	19 = 26,000,000
„ 30 ...	...	22 = 26,000,000
Oct. 2 ...	...	25 = 27,000,000
„ 5 ...	1·5 = 400	33 = 33,000,000
„ 6 ...	3 = 800	50 = 45,000,000
„ 8 ...	4·4 = 1120	50 = 43,000,000
„ 10 ...	2·5 = 630	60 = 51,000,000
„ 12 ...	...	45 = 39,000,000

—(G. P. Bond, "Math. Month. Mag." Boston, U.S., Nov. and Dec., 1858.)

The comet of 1843 (i.) was one of the finest that has appeared during the present century. It was first seen in the southern hemisphere, towards the end of the month of February, and during the first fortnight in March it shone with great brilliancy. It was not visible in England until after the 15th of March, when its splendour was much diminished; but the suddenness with which it made its appearance added not a little to the interest it excited. The general length of the tail during March was about 40°, and its breadth about 1°. The orbit of this comet is remarkable for its small perihelion distance, which did not exceed, according to the most reliable calculations, 538,500 miles; and the immense velocity of the comet in its orbit, when near the perihelion, occasioned some extraordinary peculiarities. Thus, between February 27 and 28, it described upon its orbit an arc of 292°. Supposing it to revolve in an ellipse, this would only leave 68° to be described during the time which elapses before its next return to perihelion.

It has been thought by some that this comet was identical with those of 1668 and 1689, but so little is known *for certain* about the latter, that we are not yet in a position either to admit or deny the identity of the three bodies.—(*Vide* Cooper, "Com. Orb.," pp. 159—169.)

The comet of 1811 (i.) is one of the most celebrated of modern times. It was discovered by M. Flaugergues, at Viviers, March 26, 1811, and was last seen by Wisniewski, at Neu-Tscherkask, August 17, 1812. In the autumnal months of 1811 it shone very conspicuously, and its great northern declination caused it to remain visible throughout the night for many weeks. The extreme length

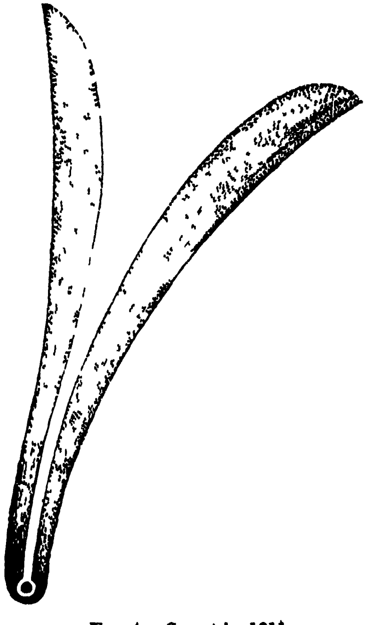


Fig. 4.—Comet i., 1811.

of the tail, about the beginning of October, was 25°, and its breadth at the same time 6°. Sir W. Herschel paid particular attention to it, and the observations which he made were very valuable. He states that it had a well-defined nucleus, the diameter of which he found, by careful measurement, was 428 miles, and of a ruddy hue, though the surrounding nebulosity was of a bluish green tinge.—("Phil. Trans.," 1812, pp. 115—136.)

There is but little doubt that this comet revolves in an elliptic orbit. Argelander's calculations, which are the most complete that have been made, assign to it a period of 3065 years, subject to an uncertainty of 43. ("Astron. Jahrbüch," 1825, p. 250.) The aphelion distance is fourteen times that of Neptune, or, more exactly, 40,121,000,000 miles!

Our limits do not permit us to describe any more of the celebrated historical comets; they are too numerous.

Eastbourne. GEO. F. CHAMBERS.

DESCRIPTION OF A NEW MICROSCOPE.

THE instrument represented in the accompanying engraving is the sole invention of the eminent opticians, Messrs. Powell and Lealand, 170, Euston Road, and is the result of much and careful study. It has only just been completed, and the following is the first description of it:—

A, Three strong legs, so arranged that the whole instrument is suspended by them with the most perfect steadiness.

B, Socket, in which the quadrangular bar F works, and into which at *a* slide the side reflector and small condensor.

C, Brass circle, very strong and steady, at the top of which is a plate of gun-metal, very finely graduated in quadrants.

D, Appliance for the under stage, strongly affixed to the brass circle *c*, having rack and pinion motion in connection with the milled head *b*.

E, Mirror three inches diameter, plane and concave, with double arm for oblique illumination.

F, Quadrangular bar working in socket *b*, by rack and pinion motion in connection with milled heads *c*, one only to be seen.

G, Arm containing the mechanism of the slow motion, worked by a very fine screw in connection with milled head *d*, which is graduated, the arm itself being strongly affixed to the quadrangular bar *f* by the screw *e*.

H, Compound body, with spring tube *f*, for applying the object-glasses, and connected with the fine motion worked by milled head *d*. Inside the compound body is a draw-tube graduated to four inches in the tenths of an inch, the eye-pieces sliding into the draw-tube.

I, Huyghenian eye-piece, of which five are supplied by the makers.

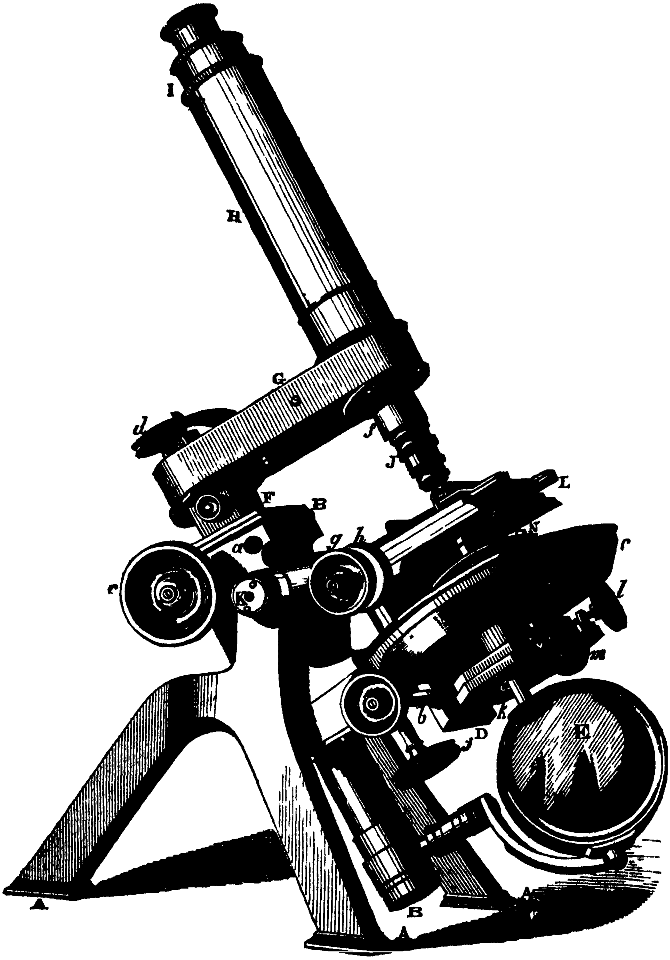
J, Achromatic object-glass, of which thirteen are supplied by the makers, viz., two inch, one and a-half inch, one inch, two-thirds of an inch, one-half of an inch, four-tenths of an inch, three of one-quarter of an inch of varied apertures, one-fifth of an inch, one-eighth of an inch, one-twelfth of an inch, one-sixteenth of an inch.

K, Axis of the instrument firmly working on the supports of the two front legs, so that the entire instrument is capable of any inclination from vertical to horizontal, remaining perfectly steady without clamping, in whatever position it may be placed.

L, Upper stage, with three-quarters of an inch rectangular motion by screw and pinion connected with the milled heads *g*, *h*, *i*, the last not seen; this stage has a sliding plate and spring clip for the objects, also a clamp to fix it, and graduated scales to act as a finder, in order to register any particular object; this stage is strongly affixed to an inner circle, working entirely round the outer circle *c* by rack and pinion in connection with milled head *j*; this inner circle has a small vernier, which, with the graduated edge of the circle *c*, acts as a goniometer, and also as a register to know the position of the stage for any particular object. The whole of this motion is so concentric with the optical axis, as to keep any object completely in the field, during an entire revolution using the one-twelfth object-glass; the stage itself is very thin for oblique illumination either by the mirror or the achromatic prism.

M, Under stage, with rotary, rectangular, and vertical motions: milled head *k* for rotary motion; milled heads *l* and *m* for rectangular motion; milled head *b* for vertical motion. This stage is for the adaptation of the achromatic condenser, polarizing prism, paraboloid, dotted lens, etc.

N, Achromatic condenser of 170° aperture, the working powers of which are admirable, easily resolving the Amician test in squares with one-twelfth and one-sixteenth object-glasses; it has a diaphragm with eleven apertures and three stops, capable of being placed in any position.



Powell and Lealand's New Compound Achromatic Microscope.

___ instrument is remarkably steady, every motion as near perfection as possible, and it certainly reflects the highest credit on its distinguished makers.

E. G. Lobb.

WHY A RIB?

"And the rib, which the Lord God had taken from Adam, made He a woman."—*Genesis* ii. 22.

But a short time since, when the theory of progressive development was gradually wearing to its last shreds, it would have been needless to cope with, and answer, that theory as an indispensable preliminary to the present consideration. There were then very few, even of "the liberal schism," who cared to insist that man was lineally descended from the monkey, whale, or fish; or even that the fish-like whale or porpoise had any rightful claim to a veritable piscine ancestry.

Those pseudo-scientific influences which had formerly perturbed us in the perusal of the Mosaic version of this world's history were losing their effect; and even the last-finished phase of prejudice which leads us to adopt, at any risk, that opinion which *appears* most free from prejudice, was growing a little less despotic than it had been a few years before, when the propounder of a new uncongenial theory had only to "know that our nature's prejudices would, of course, deter us from belief," in order to insure a pretty long list of would-be "liberal-minded" sympathizers. So the author of "Vestiges of Creation" did not omit to admonish us that there would be many who, from a repugnance to the humiliating idea of "a monkey origin," would never accede to the conclusions he had come to; and this admonitory appeal was not the least effective part of his argument. It is, indeed, so hard a thing to examine and decide upon any subject merely in reference to its own intrinsic merits, and without reference to motive, person, and the like, that the same argument has actually different values, according to the known vocation, etc., of the person arguing. As if, for instance, a clergyman should, in the course of a *purely scientific* investigation, arrive at some evidence favourable to Revelation, the result would not carry the same amount of conviction to the mind of the reader as it would if a layman had announced it—a fact which would seem to imply that, excepting the subject be strictly mathematical, we decide upon circumstantial rather than upon logical evidence. Not meaning, thereby, that such circumstantial evidence is not logically taken, but that instead of determining how far an author's conclusions are compatible with his premises, we prefer considering what *general probability* there is of his conclusions, together with his premises, being true. In short, we look ever to a final result. We do not say, "If man has a free will, he is a responsible agent," but, ignoring all conclusion hanging on an "if," we say, "Has man a free will?" "Is he responsible?" etc.

Is it not this, our habit of contemplating a final result, that the Germans define our "absolutism?" And, certainly, we do try to determine the absolute or perfect question, instead of encountering, as they would, a part or conditional form of it, *on which* they can decide *positively*. But although this charge of absolutism is justly alleged and substantiated, it must be observed that such absolutism regards more the question than the answer, seeing that though we ask an absolute question, we seldom or never answer it absolutely; whereas the Germans, though they put a conditional question, do answer it absolutely.

Indeed, it may be shown, by endless examples, that we look ever to the final and absolute bearing of things, saying, as we do, "If this be so, what, then, does it drive at?" Nor is it less notorious that, after a thing is *proved satisfactorily*, we say, often (to the disgust of the scientific), "We should like, nevertheless, to hear what may be said on the other side;" in confirmation whereof, witness the prolonged discussion publicly granted to a subject so scientifically settled as the moon's rotation.

We are, in truth, anything but absolute in our worldly convictions, whatever the Germans may say of us. We neither believe in absolute decrees of science, nor in absolute decrees of governments; and it betrays, perhaps, some want of logical discrimination to affirm that we are absolute in anything, excepting in a wish to be absolutely experimental and practical, or in an absolutely obstinate distrust of all absolute demonstration that experience has taught us to doubt.

That this conservative adherence to old common-sense, as a general, not absolute, arbitrator, is eminently unprogressive, and has, for one of its results (if it have any), a retardation of scientific progress, is readily granted, but granted of its immediate results only, inasmuch as its ultimate tendency (the thing we look to) is to save us from accumulating a number of dangerous delusions, scientific and other. The German, ignoring his heart, may trust his head implicitly; the Briton trusts neither implicitly, but acts upon their joint stimulus; while the world, probably, gains more truth by this diversity in the modes of seeking her than it would if the processes were identical.

How far we might safely make some concession to the German school, and become a little more confident in logical analysis than we are at this moment, is much too absolute a question for the writer of the following essay to decide. On the one hand, there is prospect of stagnation; on the other, of progress. Prove and believe absolutely the impracticability of perpetual motion, even, and you close one field of general inquiry that might yield a harvest of discovery, though not that one contemplated; for the personal probing [illegible] impossible" is a gain which [illegible] who accepts another's [illegible]. On the other hand, prove and believe the impossibility of "squaring the circle," and you may save a great deal of lost time and labour.

There is a balance to be struck, and the English mind naturally turns from an exact investigation to one of general import, and, admitting that there are some few physical facts irrefragably proven, takes into the consideration the probability that our national incertitude on scientific conclusions, will guard us from granting anything that is not irrefragably proven; and also that an attempt to demonstrate absolutely will be a wholesome exercise at least for us who are unused to it; and, finally, that a competent mastery of continental philosophy is hardly compatible with the somewhat imperfect analysis in vogue. But it is probable that the amount of concession to be made by us will be rightly determined by the necessities of the time, the want dictating the supply; whilst it must be acknowledged that any attempt to adopt a foreign model, whether in politics, science, literature, or art, has ever been fraught with failure.

In debating the *pros* and *cons* of this subject, one thing should not be forgotten: No nation has written, or attempted to write, so few full and comprehensive treatises as the English. We do not treat our scientific subjects so exhaustively as the continental *savans* are in the habit of doing, but rather content ourselves with short special treatises, essays, and papers; a "Systema Naturæ," or a "Kosmos," not being of our products. Take our medical school, of whom this is specially true, and mark the result of this immethodical tendency. Our doctors, as they are called, surgeons, and physicians, are eminently practical men; lecturing to their classes learnedly and originally, yet seldom even publishing their lectures (many of the best lectures have not been published), contributing occasional papers to be read at learned societies, publishing essays on special subjects, and observations and discoveries in the course of practice; but never producing voluminous and comprehensive treatises to compare in magnitude or completeness with those of France and Germany; and yet, if we think over the most significant discoveries in anatomy, physiology, and pathology, we find the names of Englismen coupled with these: Harvey with the "circulation;" Jenner with "vaccination;" Bell with the "nervous system;" Bright with the "kidneys;" Addison with the "lungs and supra-renal capsules;" Hilton with the "larynx," etc.; and with all this valuable and noble result, we have no instance in this country of any school of science being long governed by some persistent erroneous dogma. With a greater faith in "the demonstrated," indeed, we could hardly enjoy this immunity; but, as it is, there is no need of some prevailing spirit rising up to controvert a new doctrine, however false and powerfully supported: it will be doubted, in course of nature, as the sparks fly upwards; whilst ill-supported or fanciful theories which, from our very want of exact logic, are apt to take a sudden and passionate hold of public opinion, will soon wear out their popularity from the very fact of our never having regarded them as proved, as in the case of this "Progressive Development theory," which, at the time referred to, had dwindled into insignificance. But if, on the one hand, a theory is not considered *proved*; on the other, it is not considered *disproved*. It perishes gradually for want of constantly accumulating evidence, but only from this want; and accordingly we find, now that an abler advocate has presented it (or something akin to it) more practically, logically, and modestly, the progressive theory is on its legs again. So the great Newtonian principles are being constantly reinforced by our daily experience of eclipses and other phenomena which they predict; whilst other sublime principles laid down by that philosopher, but wanting this daily evidence of a truth which they possibly possess, are debated and doubted without scruple. And this state of public feeling is on the whole a safe one.

But to return to Progressive Development. It was said that a little while back there would have been no need to preface this paper with any refutation thereof, or allusion thereto; but now that Mr. Darwin has so ably advocated this theory, or something very like it, it is necessary to examine how far certain deductions that may follow from his doctrine would seriously invalidate, or utterly negative, the views we are about to take.

Now, admitting the probability of Mr. Darwin's ingenious and admirable account of the orgin of species, and the validity of all those evidences adduced in proof of the *physical* structure of animals having a tendency to occasional higher development, and of these higher developed individuals, under favouring conditions, becoming the specific standard, till a change of conditions shall produce a new development in turn to become standard, and so on indefinitely, we do not understand him to assert positively that a low mammal must necessarily have been developed from a high reptile, or a low reptile from a high fish! Much less do we understand that our *physical humanity*, in its lowest phase, was necessarily developed from "the greater ape." But supposing this doctrine tends only to countenance this conclusion, it could then only regard the physical morphology of man; since while there is no evidence that the brain of a gorilla is more sciential than that of an elephant (much further back in the physical series of which man is the last form), we can hardly conclude that intellectual development is necessarily commensurate with physical, and much less that human intellect is derivable from brutal. But if, after so many gratuitous concessions, we were to grant that at last *physical* man—that is, human form—did progressively appear on this planet at a particular point of time, there seems no good reason why that fact should not be referred to, and esteemed, as man's creation rather than that gradual development occupying the preceding time. But when we further consider that the characteristic intellect of man, which we cannot legitimately *derive*, appeared also at that time, since man, to be such, must have human intellect, we are most strictly bound to regard this fact as the man's creation. Therefore, if the words of the Mosaic account, "the forming man of the dust of the ground," be understood to signify the progressive development of all animal structure up to the human form, the "breathing into his nostrils the breath of life" must at least mark the consummation of that development, the virtual creation of man, who then only "became a living soul." So far, then, there is nothing in this doctrine at variance with the Mosaic account of man's first appearance upon this stage of life—a consideration, truly, which should nowise affect the investigation of natural science, while that investigation is strictly physical; but when our induction is to be strictly metaphysical, as in the present case, we must consider how far its truth may be affected by anything whatsoever.

Our present subject is a consideration of the Mosaic account of the creation of woman, and a suggestion grounded thereon; wherefore any argument which should invalidate that account would equally invalidate our suggestion.

We think we have shown, then, that the Progressive Theory in its present state does not invalidate the Mosaic account, and believe we may safely assert that there is no other scientific evidence to negative our acceptation of this account of man's origin, simple and general as the account is. The present paper, which does not attempt to go into the subject *in extenso*, will be merely an inquiry into the significance of the text quoted by way of motto, and a statement of what inferences appear inevitable touching the amount of scientific insight which must be ascribed to the author of that text, if we suppose him unenlightened by superhuman wisdom, or uninstructed by divine command. It should further be premised that this consideration is not treated philologically; the sense of the original text being sufficiently elucidated in the context, which proves that the word rib (so translated in our Church Bible) could signify that bone only, as it was taken out of "Adam's side."

Let us suppose ourselves unfamiliar with this biblical account of woman's creation, and hearing it seriously announced for the first time that the basis of her construction was, in all probability, a man's rib. Would there not follow a long silent inspiration by way of commentary? Should we set about balancing the *pros* and *cons* of the hypothesis, or be ominously conjecturing as to the sanity of its originator? Irritating to the philosopher of this time that such question must ever be open to opinion! Quite impossible to prove that but for biblical authority this hypothesis would strike us as the fancifullest of dreams! Hopeless uncertainty! We were children when the story was read to us; then all new things surprised us, and if we could remember any thrill of astonishment on hearing how the deep sleep fell on Adam, how would that prove the effect of such a statement coming quite fresh on the ear of an adult?

Howbeit, the man was placed in the world, and some things appear to have been uttered then, or soon after, about how, why, and on what conditions he was put there. Some of his truth-seeking offspring do ascribe such utterances to the Supreme Maker of their first parent, while others, equally truth-seeking, ascribe them to his children removed some generations. And though we say our conviction that these utterances will finally be accepted by consummated science, and this conviction is of faith and not of science, yet it does appear from time to time that new utterances transpire at each new birth of travailing science that seem to sing an antiphone to those primal utterances. Indeed, it becomes important, in honestly viewing this subject, to bear in mind how, if not incredible, yet how inscrutable or vague some of these utterances sounded erewhile that are now neither doubted nor marvelled at as at all inconsistent with "the credible of today;" how our belief in the facts of Scripture necessarily widens, even though our faith in its origin should contract! For, seeing that of these early utterances there are still a great number inscrutable, or not understood, in order to settle the probability of their ever being understood, should we not remember how some of them, once equally unintelligible, have outgrown that condition? Would not the exhumations at Nineveh have answered some doubts of the sceptics at the beginning of this century? But, disregarding all extrinsic evidence, let us take the Scripture facts as we find them stated, and observe what results from their analysis.

Take this fact, that very anciently some one wrote, that 'after making a man, his Creator took one of his ribs, and made that rib a woman.' We think now a statement like this, based upon mere human authority, would, a few years ago, have provoked laughter, or surprise, at least; but we may say certainly that it would, in any case, have been held fanciful and empty of scientific evidence. Recent science, however, and principally Professor Owen's laborious researches, have attached such significant import to this part of the skeleton, that, of all parts which could have been named and understood by man, prior to his acquaintance with human anatomy, this appears to be the one element which Nature would have selected in order to develop "an helpmeet" for the intellectual being previously formed; or, in other words, this selection appears best to comport with a system of development that is now supposed to modify the vertebrated archetype into mammal, reptile, bird, or fish.

Now this development, it must be observed, is altogether different from that contemplated in the progressive theory already referred to, which associates the condition of immense periods of time as an indispensable means to the end. Professor Owen's doctrine has nothing to do with time—nothing to do with speculations concerning the effects of time; but, examining Nature *as she is*, discovers in all those numerous animals we call man, beast, bird, reptile, and fish, an identity of plan and design that is obvious and unmistakable. There is one common type for the foundation of all these—certain elementary parts, bony or cartilaginous, which, variously developed, are the skeletons of various animals. Thus, one development of certain of these elements results in the fin of a fish, another development of the self-same elements in a man's hand, another of the same in a whale's paddle, or a bird's wing.

But there are no signs of progress in this development: the so-called higher animals, man included, do not show a greater development of the common elements or archetype —often a less—as witness the immense development of a shark's jaw, a giraffe's leg, neck, and tongue, a bat's wing, or a monkey's prehensile tail, as compared with a minor development of these in man. But it may be answered that such development, though larger, is not so perfect, as owning less versatility of functions. This is not so, since the prehensile tail of a monkey owns the function of a hand, whilst the corresponding human elements remain undeveloped, and are four little bones perfectly hidden and immovable. Then the foot of the monkey does not only walk but manipulate; and the mouth of a bird is not only a mouth but hand also. It is plain, then, that there is no gradual progress towards a perfect development of all, but that each of these elements is perfectly developed in behoof of the destination of each. For a creature that feeds on leaves, the development of a sloth is perfect; for he who "feeds on thought"—to cite Milton—the development of man is perfect; and it is only because we rank intellect above all other attributes of life, that we are logically justified in placing man the highest. Indeed, but for the concession (which we cannot withhold) that it has pleased the Creator to adopt this uniform plan in the development of all those various forms of life enumerated, we might be tempted very often to find fault with the design; neither can we quite see how any progressive theory disposes of this difficulty. But be that as it may, we have nothing more to do with it at present. It has been shown that its speculations do not invalidate the statement in our text, and it remains to be considered in detail how the not-speculative but factful observations of Professor Owen may elucidate its seeming mystery, as we have just now broadly intimated—may answer the question, "Why a rib?"

When we consider the bony fabric, or what might aptly be called the foundation and support of the body, whether of man, quadruped, reptile, bird, or fish, we should endeavour to conceive not of a number of variously-proportioned bones following the general form of the animal, but rather of a compacted chain of bony segments, reaching from end to end of the structure, in the form of a column, or long axis, from which the limbs are developed; the number, form, or development of these segments varying with the genus of the animal.

The next step in this consideration will be to take one of these pieces, or segments, and examine it separately. We now find that it consists of a solid centre, and two hoops, or arches, springing from it, the one in front, and the other behind: the crown of the hind arch forming one of those eminences we feel on the back of a greyhound; the crown of the front arch forming the breast-bone. The back arch is occupied by nerve-matter (neurine), the organ of feeling, thinking, or willing; the front arch occupied by blood, the source of flesh or muscle, the organ of power and motion.

We have in this one piece, then, a representative of the entire man or animal. A solid central substance arming out in opposite directions (like a pair of callipers), and embracing intelligence under one arch, and physical power under the other, and uniting these as one individual. Now it is obvious, that if a number of these triple elements are in contact, or chained together, they will form three columns: the central one solid, as formed by the conjunction of the solid centres; the two others hollow, as formed by the conjunction of the two sets of hollow arches, back and front. Or, to put this palpably before us: pile up a number of pill-boxes into a column (supposing them solid); these are the solid centres. Touching this column, and, *behind* it, pile up the same number of such boxes, but from which the covers and bottoms have been removed, and so form a hollow column, or canal; and down this hang a cord. Lastly, make a similar hollow column in *front* of the solid one, furnished with a similar cord. Now the back canal, with its cord, is the spinal canal and cord, or nerve; the front canal, with its cord, is the thorax and main blood-vessel; and the solid central column, uniting these, is the vertebral column, as it is called. The back canal, with its contents, representing intelligence, will, etc.; the front canal, with its contents, representing physical power, or the material manifestation of intelligence, will, etc.

But if such a structure as this appears a very unpromising arrangement of parts wherewith to produce anything like an animal, with the exception of an eel, or a snake, we must feel fresh admiration at this fact, that simply by one new condition, "development," that is, variously increasing or decreasing these arches and centres at various points of the pile, we do have produced a man, quadruped, reptile, bird, or fish! Yet this is mere truth.

Professor Owen has shown, by analogy, that Nature has, in man, enlarged considerably the four uppermost *back* arches, and, conjoining these, has formed a large cavity, called the cranium, or brain-case, the four corresponding solid centres standing midway between this cavity and the face, which is developed in turn from the *three* uppermost *front* arches, the fourth being developed enormously into a shoulder-blade, and further prolonged into an arm and hand.

And though this account must be received as a very broad statement of the result of a very profound analysis, it nevertheless presents to us something which is very remarkable, namely, that a hand, the effective minister of the brain, is developed from one of those four pieces or segments whose office it is to hold and protect that brain. It is as if the centre of intelligence would assert and declare itself even in its far-off instrument; while, by a like law, the legs, that do "porter's work" for the mass of the body, and minister to the mind more remotely, are found to be developed from segments remote from the brain segments, but from those situate in the region of the trunk, that trunk which they carry and serve in a more proximate capacity.

And here, pausing for a moment, let us notice that, as the fore limbs or arms of brutes are developed from the same brain segment, we should lose the significance we have pointed out, inasmuch as the *fore* limbs are often less effective and versatile ministers of the "*brute-will*" than the *hind* limbs, as in parrots; but when we remember that the *brute-will* is rather instinctive than sciential, rather an irritable appetite than a cogitative design—and, moreover, that the spinal cord which extends along the trunk is quite as much the seat of the irritable instinct as the brain is—the significance reappears with no diminution of its former force.

So much for the first four segments which we have seen contributing to form a head and upper extremity, the hind arches of which form the cranium, the fore arches of which form jaws, arms, etc. Now the nature of the two developments deserves special attention, for whilst it is the special function of the hind arches to contain and protect the intellectual apparatus, the fore arches are developed into animal machinery, as jaws, arms, hands, to execute the commands of the will, or carry out the designs of the intellect. Indeed, it would appear that there is something important in the local relation of the vehicle of deliberative impulse (behind) to that of execution (in front), inasmuch as we discover a similar local arrangement in the parts of the deliberative and impelling organ itself. The spinal cord is divided into two tracts, the hind tract transmitting sensation, the fore tract evolving motion.

And now, having briefly described these elements, which, according to the degree of their development, will be found capable of converting the unpromising column we started with into the complete human creature, it may be convenient, perhaps, to furnish these with their appropriate names.

The entire column is called vertebral column, because by its being jointed we *turn*. Each threefold piece of which it consists is a vertebra, or vertebral segment, and the three parts of each segment, viz., centre, back arch, and front arch, are called respectively centrum, neural arch, hæmal arch. The back arch is called neural, because it contains nerve matter (neurine), the brain, or spinal cord. The front arch is called hæmal, from containing the blood (haima), which results in flesh (muscle).

To proceed. In the neck there is very little development of the elements of our snake-like column, the neck being literally a column, especially in birds, where we recognize the primitive columnar foundation almost unmodified. In the human neck this archetypal foundation is not only not developed, but in some degree suppressed; for while the neural arches remain as in the archetype, the hæmal arches are only found in a very rudimentary condition, even less easily recognized than in the bat (a mammal also like man). In the lower vertebrated animals, the snake and the eel, we find an observable recurrence to the unmodified archetypal skeleton, hinting of the marvellous efficiency of a design which, with slight modification, can produce creatures so various in their forms, habits, and spheres of existence.

But our business is now with the ribs. The trunk is formed by development to very great excess of the hæmal or blood-arches of the column, whilst its nerve-arches remain archetypal. These blood-arches, the ribs, inclose and protect the heart and lungs (blood-pump and blood-purifiers).

Probably enough has been said for the reader to have noticed already that between any portion of the archetype from which a new part is developed, and that developed part, there exists a striking fitness of relation. The hand is not only the minister of the thoughtful head, but it is also its outgrowth. A leg is not only a minister of the trunk, but also its outgrowth. The front or hæmal arches are not only generally associated with the blood and muscles, which are physical agents of the mind, but they likewise literally wall round and protect the nurse of these agents, the heart. And if the local relation between the deliberative and administrative sections appears in the fact that the first is behind and the second in front of the central axis, there likewise appears a corresponding local relation in the two sections of the deliberative organism itself; for, as already stated, its motor or administrative tract is also in front of its own proper canal; an analogy we have not seen instituted, however.

And yet there appears something very striking in this local relation of elements in the self-knowing, self-governing, matter-subjugating, individual man. Behind, and overlooking all, we have the supreme deliberative intellect; immediately in front of him, and obedient to his every mandate, stands his administrative brother, who, in front of him, in turn communicates, by a thousand nerve-strings, with a multitude of physical functionaries. These are his faithful servants, who traverse the material world, make war upon, and subdue it. They work natural electric telegraphs from the stars beyond our system, from sun, moon, and planets within it, and from far and near objects on the earth; and, opening the windows of his watch-tower, they present, without flattery, to their king, and at the slightest instigation of his administrative partner, the various messages they receive. They are also *en rapport* with sounds, tastes, and odours, near or at a distance, and they are conversant with wet, dry, moving, solid, and ponderating matter; they exert strategical complicated or simple forces in overcoming, readjusting, or employing this matter, and not only report its various conditions by a special medium to head-quarters, but likewise render, in minutest detail, an account of the expenditure of means and forces at their disposal.

Truly such a monarch is awfully absolute! and, unless wise and far-seeing, may be sorely tempted to overtask his ministers now and then; though, from the fact of these ministers being fearless and faithful, he will assuredly learn his error the next time they present their accounts; and, as he alone feels the pinch of misgovernment, he will misgovern at his peril. Being, then, intrinsically selfish, this little intellectual kingdom will never be misgoverned wilfully or maliciously; neither, indeed, could its government be improved, provided there were to be no more such kingdoms in the world. But so soon as we extend the design, and contemplate the existence of many such kingdoms, a gaping deficiency appears; as it is most certain that each intellectual kingdom will make war upon the other as ruthlessly as it does upon brute-matter. What is to prevent this?—not the sympathy which made it true to itself, because that sympathy is confined within its own walls, and afforded only to its own subjects from a selfish consideration of king intellect, to whom all acts are finally referred. It is, then, impossible to have society unless there be another sympathizing power extending beyond the intellectual self, and which we name love and charity, to divide sway with the otherwise absolute intellect.

Now to return to development. If any bold theorist of the present time were to pretend to tell us in what order, and from what primal elements, the Creator had formed the various parts of the first male human being, and were to assert that the receptacle for intellect and the canal for sensation were first formed; and then that a minister of intellect, an upper extremity, was produced from that protective receptacle: though we might smile or tremble at his audacity, we should at once know whence the hint of such a theory was derived. No contemporary of Aristotle or Harvey could have told us this: the theory, however unjustifiable, must be associated with the science of to-day. And if, in following his hypothesis of the development of female humanity, we were to find him inculcating (what we all admit) that male humanity alone is not complete humanity, inasmuch as it would be all or mainly mental or speculative humanity, minus the emotional and charitable; and then if, puzzling whence to develop a satellite for the masculine intellect, we were to find our philosopher determine that it must needs be from some emotional element already existing in the first human being, and one which performed instinctively kind offices for him independently of his mind and will; we should say that any elegant-souled Greek might have thought this; and would probably have fixed upon the heart—the unselfish organ, devoted all its lifetime to the welfare of the lordly intellect, and his dependents; and moved to this by a divinely implanted stimulus of instinct, not reason. Only obtain a being ruled by this characteristic, to balance the tyranny of intellect, and it would be possible to have society. Very Greek this, and very good! But if our theorist, demurring at the last step of this development, said, "No; not the heart!—that is not *primitive* enough for *an element*. The heart nourishes the muscles, the muscles serve the bones, the bones are the levers of the will, and protectors of the nobler neurine. It must be a bone, then, an element of the archetype, and *identifiable only* with the heart: a hæmal arch; a rib, in fact." If we found our theorist say this, we might think it as absurd as we pleased; but no future generation would take him for a contemporary of Aristotle or Harvey. He would be a man of the nineteenth century.

Whether is it probable that he who wrote the Scriptural account of Eve's creation was acquainted with this our state of homological anatomy? or, Did Omniscience, well knowing the future (not to Him future) import of this rib-bone, dictate it to the writer, perhaps in order that his later posterity might recognize the original voice? or, Did the writer 'hit on the idea by chance?' If the last, was it the same chance suggested the Talmudical idea that the whole body would finally be resuscitated from the "sacred bone," the single undeveloped *centrum* of the series? Nothing now more easy than to imagine such a theory? The only undeveloped solid vertebra (to adopt the views of Owen), minute and marvellously durable; "a moody Pharaoh," in the words of Browning, to "be alive at earth's catastrophe;" what better element whence to regenerate the body? Yet this, if a scientific theory, seems a theory of 1860.

And, in conclusion, was it Chance that made the writer of the genesis referred to, omit giving a similar account of the creation of the *brute* female? The *brute* male, it will be remembered, is not specially intelligent, nor the brute female specially maternal and emotional, as a rule. Here, then, the emotional significance of a heart, or hæmal arch, would vanish; while we have *these two facts:* First, that we daily see male pigeons and other males of the lower animals, incubating or bringing up their young (not exceptionally, but by a normal law of Nature); and, second, that the Scripture does not say the brute female was created from the male, neither that she was formed from that segment which points to an emotional capacity.

But, if we are to ascribe to Chance both the particular enunciation of a fact in the history of the human genesis, and the absence of such particular fact in the history of the brute genesis; and to Chance likewise a curiously concurrent tradition of the Hebrews; ascribing these to Chance, moreover, because, whilst we cannot believe they were the result of the then human knowledge, we *will* not believe they were, as they profess to be, of divine origin: if we are content to grant Chance this mastery, what is there to prevent us from taking a new stand—from shifting the field of analysis, and, leaving the probable and the actual—from asking definitively, "What is Chance?" ZENO.

THE EARLIEST COINAGE OF BRITAIN.

COINS OF THE ANEPEGRAPHIC PERIOD (OR THOSE WITHOUT INSCRIPTIONS).

(*Concluded from page 28.*)

THERE was, however, still a tradition evidently afloat, among the engravers of the British mints, that the unmeaning devices which they executed for the obverse of the coins of the respective petty states, had some remote connection with the form of a human head. In accordance, no doubt, with this vague tradition, we find one of these monetary artists making a strong effort to restore the lost idea, as, while making a somewhat novel distribution of the laurel branches and leaves, with the introduction of some rows of spots to "fill up," he boldly introduced a full face below his superstructure of ornament, as shown in the annexed engraving (Fig. 6).

FIG. 6.

The gradual degradation of the biga device of the reverse followed a somewhat similar downward course. It is not possible, within the allotted space of this article, to describe the first and more slight deviations from the original;* and indeed it will be perhaps more interesting to proceed at once to the examination of one of the more striking deviations which eventually occurred. The annexed example (Fig. 7) is the reverse of one of the gold coins of the Britanno-Gallic tribes, on which the biga, or two-horse chariot of the exquisitely engraved "Philips" is traditionally and rudely imitated.

FIG. 7.

If all the connecting links could not be produced, it would scarcely be believed that such a device had any remote resemblance to the exquisite original. All the connecting gradations are, however, forthcoming, and might be exhibited in a very interesting series; and, moreover, a careful examination of the rude device under description will be sufficient to prove its parentage. In some specimens the horse has eight legs, evidently an attempt to represent, by a sort of

* See page 27, *ante.*

rude symbolism, the presence of the second horse, which the artist's manipulative skill was utterly unable to reproduce in a legitimate manner. The wheel of the chariot is represented by an ornament, which, its meaning being forgotten, is placed above the horse; and it is sometimes positively placed in front, literally realizing the old saying, that there are those who are capable of "putting the cart before the horse." Lesser circles, also the traditional offsprings of the chariot-wheels, are dotted fancifully about, and the charioteer has faded into a palm branch-like ornament at the edge of the coin.

In a still more debased example, the biga device was reduced to the barbarous attempt shown on the example engraved below (Fig. 8), probably a coin of the Brigantes; while

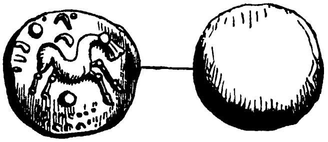


FIG. 8.

the obverse, seemingly in despair of realizing any acceptable design, was left blank. These coins were at first, as it would seem, of gold only; the full coin, or entire *stater*, weighing from about eighty-six to ninety grains, but by degrees reduced to little more than sixty grains. There were also halves and quarters of these coins, specimens of which may be seen among the illustrations to this paper. At a later period similar coins of silver were issued, while those of copper are in all probability still more recent. Most of these coins were of rich yellow gold; but there were some of a red gold, alloyed with copper, which probably bore a distinct and lower value; and some of a pale gold, like the electrum of some of the early Greek coins, produced, probably, in the British coins by an artificial alloy of silver.

These early British coins of gold and silver may be considered as the earliest native representatives of our present sovereigns and shillings; for judging by the Greek staters and drachmæ, of which they were the remote offspring, the gold coin was worth twenty of the silver. The relative value of the copper it would be more difficult to estimate.

The earliest and best imitations of the "Philips" are found in the Isle of Wight and on the south coast, in the district where the Durotriges, the Belgæ, the Remi, and the Britanni were located; while, towards the interior, this imitative coinage has evidently commenced at a later period, and is more rude; and in the north, among the Brigantes and their congeners, the rudest of all the forms are found. To this period another class of British coins also belongs.

These are the barbarous cast coins, formed of a mixture of tin and zinc, to which the rudeness of the gold and silver coins just described must be considered as a kind of high art. Till recently these coins have formed a standing puzzle to British numismatists, both as to their date and character, and the nature of their barbarously executed devices. It appears, however, from more careful and accurate investigations, that they may be assigned to the latter portion of the period of the anepegraphic coinage, when no legend accompanies the devices; their devices being, like those of the coins above described, debased imitations of those of the gold "Philips." The obverse is evidently a rude attempt at the head of

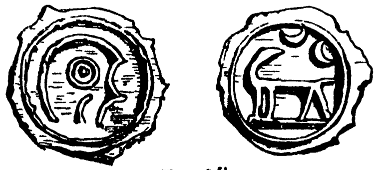


FIG. 9.

Apollo, confined to an outline and a circular eye (Fig. 9); while the reverse is plainly the horse of the biga, though reduced to the form of a four-legged bench, with one end turned up, the chariot wheels appearing in two semicircles above. These most rude specimens of the monetary art were evidently cast in wooden moulds, as the grain of the wood can be plainly seen. From the nature of their fabric, it is conjectured that they were not money of the state, but issued by private individuals as small change; of which, no doubt, a great want existed in consequence of the high value and scanty supply of the gold and silver coinage. If so, they may be considered in the light of tokens, just such as were long afterwards issued by private persons, in the time of Elizabeth and James I., to supply a similar want.

Such appears to have been (as far as can be known from the present state of our information on the subject, and the limited supply of monuments) the condition of the native British coinage previous to the intercourse with the Romans, after Cæsar's first invasion. After that period, when a more extended intercourse took place with the more southern and partially Romanized provinces of Gaul, and led to a fuller knowledge of the state of the coinage of those districts, the names of cities and chieftains began to be placed on the public money of Britain, in the same manner as had prevailed for some time in parts of Gaul. The British coins with inscriptions form, therefore, a distinct and natural epochal division of the subject, which will afford very interesting matter for my next article.

Of the characteristic form of the series of coins just described, I have said nothing, though it is sufficiently peculiar to merit a passing remark. The Greek coins, of which they were copies, though so exquisite in the artistic treatment of their devices, were, in general form, little better than the rude copies which they gave rise to. The mechanical part of coining, in all that regards a true circular form and even edge, never attained in Greece to a much higher degree of development than that exhibited in their money of the very earliest periods, when the device occupied one side, and the rude punch-mark, by means of which the front of the piece of metal was driven into the die, the other. It could not, therefore, be expected that the rude monetary artists of Britain, while they failed to produce even a respectable approach to the Greek devices, should attempt to surpass their models in the mere mechanical features of their fabrication. They are, in fact, very similar to Greek coins, in this respect perhaps quite as good, but have one feature, which, in a decidedly marked degree, is peculiar to them; that is, that while they are, like the Greek money, very thick in proportion to their extent of surface, they are distinctly convex on one side, and concave on the other—a peculiarity not found to the same degree on any other class of coins.

H. Noel Humphreys.

BIRD-MOUNTING.

We will suppose that a proficiency, from practice, has been attained in the art of bird-preserving, according to the instructions given at page 117 of the first volume. The proficiency in preserving may apply only to the preservation and the form, great and necessary things, no doubt, as preliminaries; but, like matter without manner, of little avail alone. For attitude, I would say, as has been said to many a young artist, Go to Nature, and there you will find an original in perfection. Would you make a willow-wren look like a willow-wren, watch him as he there hangs upon the weepin [illegible], or stands on a bough peering in q[illegible] food. Each bird has its own man- [illegible] if you cannot hit the manner, or [illegible]our stuffed skin so far amenable as to [illegible] the attitude, it is either ill-stuffed, [illegible] want the requisite knowledge of that [illegible] you should copy. Young hands com- [illegible] suppose that a bird should stand bolt [illegible]ht, with the legs almost perpendicular, [illegible] right angles to the perch. This is a [illegible] mistake, and never to be found in [illegible]ure. Do *we* stand rigid, like a foot-soldier [illegible] drill? Does not a bird, as well as our- [illegible]lves, accommodate itself to the thing upon which it rests? Assuredly it does; for birds do not, as a young bird-stuffer endeavours to do, find always a perch to rest upon in the plane of the horizon. It therefore follows that, as he keeps himself upright, his legs must accommodate themselves to his perch (Fig. 1). So in the ground-birds there

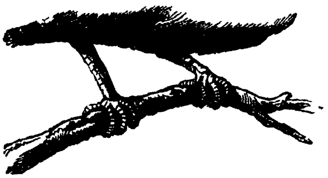


Fig. 1

is a gentle slope backwards from the hind toe, the balance being preserved in both cases by throwing the body forward in proportion. It is not uncommon to see birds preserved with wings and tail spread. Now, ordinarily speaking, this is very objectionable, because very unnatural. A bird preserved is supposed to represent a bird in a state of repose, that is, not in flight; the only modification allowable being with regard to those birds whose manner it may be to have the wings more or less open on occasions: thus the falcon tribe, supposing they are represented as devouring a quarry, or two birds toying with each other. It may be that a bird essentially aëreal, like the wift, or perhaps some of the terns or the frigate-bird, may be represented as actually on the wing. In this case, of course, the wings must be spread; and this is best done by passing a wire, not too thick, from the base of the quill-feathers on the under side, alongside the bone into the body, where it should be carefully and coaxingly inserted towards the tail until you feel that you have a pretty good hold. You may then pass it carefully under the longest quill-feather, and through the back of the case, and fasten it by bringing it back again through and clinching it, concealing it so by the oblique position of the bird that it is not detectable. It is obvious that by passing the wire alongside the bone, you may bend the wings to any angle you please. With regard to the case there are two methods: one a bell-glass, which, glass being now so reasonable, is certainly a very pretty and reasonable way of mounting, but inapplicable to birds which are to be placed on a wall, or to be represented flying; although this may be managed by attaching one wire from the point of the wing to a twig sufficiently firm, which it will scarcely appear to touch, if managed adroitly. It is likewise indispensable that a bird for a shade should be stuffed so well, as to look nicely in all positions. One thing must always be remembered, *do not have your case a shade too large,* just clear the object so as not to stint it for room; and in flat cases this applies chiefly to depth, for it should have sufficient light, or it will not look well. Wooden cases should be made as slight (in thickness) as is consistent with firmness; well-seasoned white deal is best; and the case should be formed of back, top, and bottom, open at the front and sides, and at each corner of the front two slight deal supports, rabbited on their inner edges, and presenting on the whole this appearance.

Having the case prepared, it should be papered with ordinary demy paper on the top and back within, and when the paste is dry washed over carefully with size and whitening, tinted with a little stone-blue; some add some touches of white subsequently to represent clouds, the ground representing the air; some also paste a landscape on the back, but this must be good, or you had better have plain colour. The bird to be

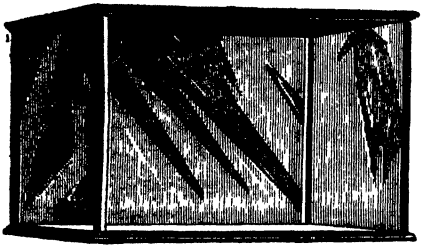


FIG. 2.

placed in this case is either perching, standing, or flying; for the latter directions have been given. As to the two former, the perch must be firmly fixed in the small piece of flat wood upon which it previously stood, and put in upon it, the wood being fastened to the bottom of the case, either by screwing from below, from above, or gluing with stout glue, or by passing wire through two holes in the bottom of the case and the wood, and clinching above; in this case, or in screwing from below, let the wire or the screw into the wood, and putty over, and so if the bird is represented standing. The bird being fixed, the next thing is the decorating or "weeding," as it is technically called, and here we enter upon a subject so entirely of taste and fancy, that no fixed rules, as to the disposition, can in all cases be given. One rule applies equally to this as to landscape painting, viz., that there should always be a compensation of objects; that is, if you have a tuft of grass on one side which rises towards the top of the case, there should be something in the lower opposite corner to strike the eye, but not to rise above the midway up at furthest, and the ground, or floor, should not be over-furnished with moss, etc. After the bird is fixed, the whole bottom should be carefully glued over with thin glue, taking care, where the bird's feet are on the bottom, not to touch the toes with the glue, [illegible]e fine-sifted sand or gravel should [illegible]e sifted over it, and it will adhere [illegible] the glue has touched; for this pu[illegible] small tin shovel is best, something [illegible] form (Fig. 3), and about two inches [illegible]

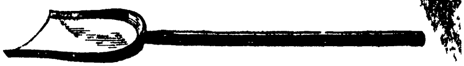


FIG. 3.

by four long, with a handle in proportion, which can be made to order at any tinman's for a trifle.

Everything used in "weeding" should be baked in a slow oven, otherwise spider's eggs and minute creatures, which are pretty sure to be contained in it, will make their appearance after the case is closed in the disagreeable form of destroying your specimen. Moss, etc., by being slowly dried, will also keep its colour better. Yellow moss, found on the roofs of old barns, and dark gray of the same species, are very generally useful; and where yellow moss cannot be had, the white or gray may be coloured with chrome, and looks as well. Water plants fade, being more or less succulent, and hence a little common water-colour with gum will be used with advantage and look less artificial than oil-paint which is often used. Fern looks very pretty as an adjunct for heath-birds, but it should be dried gradually and carefully, when *quite* full grown, and a small touch of light green, permanent white forming a portion of it, will give it a freshness and more natural appearance. Grass in seed (not in flower) of various kinds is also a very pretty addition; but bird-preservers have a habit of using dyed grass, and yellow and red *Xeranthymum*, or Everlasting, which is certainly to be avoided, and indeed anything which is unnatural. If it is wished to introduce a lump of earth, or an apparent bank, a piece of thick brown paper, bent to the requisite shape, and glued over and covered with sifted sand or gravel, has a very good effect; but insects and butterflies, or artificial flowers, unless they are extremely natural, should certainly be avoided. Regard should also be had to the season at which the bird is usually seen. For instance, summer birds are, of course, surrounded by green and living objects, but autumn or winter visitants by decaying or dead herbage. It has often been made an experiment to represent snow, but it is difficult to obtain anything white enough, and at the same time of a chrystalline character, which, of course, it should be. Potato farina nicely dried, mixed with Epsom salts pounded very fine, does not make a bad substitute; but the real difficulty lies behind, namely, the fixing it, and, more than all, the least damp takes very much from its appearance, if it does not destroy the effect, and hence we must have recourse to mineral aid, and any very white mineral powder mingled with pounded glass, is perhaps best. It is unnecessary to say that the herbage upon which it is meant to rest should be touched all over with paste, not glue, and the white mixture shaken over it and left to dry. What will heighten the effect very much, if prettily executed, is a back landscape with a dark leaden sky and nearly black earth mingled with moss. To represent water, a small piece of looking-glass, surrounded with moss, etc., answers very well. The bills and legs of birds should be always varnished, and where the natural colour fades after death, it should be restored by a thin coat of oil-colour of the required shade. The bird being fixed and the case garnished, nothing remains but to put in the glass; this is in three pieces, one for the front and a piece at each end. This can be pasted in with very strong paper round the edge, advancing sufficiently over the glass to hold it. In doing this it is not necessary to be very particular to avoid pasting the glass, as after it is dried it can be wiped clean with a damp cloth. The last operation is a very simple one, and done in a few minutes. You must procure some black spirit-varnish, which you can make yourself by dissolving the best black sealing-wax in spirits of wine, and should be kept corked; when this is good it acts as paint and varnish at the same time, and dries as fast as it is put on. One or two brass rings screwed on at the top of the back of the case, will finish the bird, and if the case be nicely and closely made, there is no limit of time to which the preservation of the specimen may not extend. The preservation of animals and mounting of insects are very different, and much more difficult matters.

O. S. Round.

HOW TO BOX THE COMPASS.

While trying to learn to perform the operation of "boxing" the compass, I observed the following method in the naming of the points, and directly I perceived it, I found I could box the compass without any further study or trouble. The points are named in three classes:—1. The four "cardinal" points, North, East, South, West. 2. The middle points between those of the first class: North-east, South-east, South-west, North-west. 3. The middle points between those of the second class: North-north-east, East-north-east, East-south-east, South-south-east, South-south-west, West-south-west, West-north-west, North-north-west. The third class points, however, may be considered as two positions of the second class points. Now, each point of the first two classes has two positions, one on each side of it; for instance, taking the North, it has the two positions, North by East and North by West, and the same with the others. These complete the thirty-two points. In boxing the compass, you should begin with North by East, and finish with North. Any one bearing in mind these observations, will be able to name the points without letters. E. H. Swann.

SHADOWS ON WATER.

It may, by multitudes of persons, be considered a strange subject of controversy "whether shadows are cast on water or not." Not a few will be ready to say, "Why, who that ever read the fable of the Dog and the Shadow, or who that ever looked into a puddle, can doubt of that?" That is to say, there are yet persons to be found who have not learned to distinguish between *shadows* and *reflections*. But these apart, most persons will be apt to think that a controversy about a thing so easily decided must be ridiculous. Nevertheless, there are both uncertainty and dispute about it, and that, too, amongst landscape painters, both amateur and professional, the very persons to whom the question is of most practical importance, and whose observation, we should have thought, would so easily decide it. Three or four years ago we came upon an artist, painting in a tent on the margin of Rydal Water. We found that Mr. C—— had travelled in Italy, and, though young, he was so far an experienced artist that we recognized the picture in the exhibition of the following year; yet, on our putting the question to him on a spot so pertinent to the inquiry, we found him unprepared to answer it. There are, in truth, some practical difficulties in the determination of it; and a knowledge of some optical principles is required for it, which, it is evident, artists and critics do not always possess. We have to distinguish not only between shadows and reflections, which is not always quite easy, but also between shadows, if such there be, upon the surface, shadows on the bottom, and shadows on opaque matter suspended in the water. Our own attention was drawn to the subject some years ago by a passage in Mr. Ruskin's "Modern Painters," in which we clearly saw that there was some misapprehension, though we could not exactly determine where it lay, and which has recently been criticized in the violent terms used in the following passage, taken from "Blackwood's Magazine," which places the subject before the reader in the words of the disputants themselves:—

"In the first volume of 'Modern Painters,' Mr. Ruskin lays down the law upon the subject of the effect of shadows on water in the following words:—'Water receives no shadow. * * * There is no shadow on clear water. If it have rich colouring matter suspended in it, or a dusty surface, it will take shadow; and when it has in itself a positive colour, as in the sea, it will take something like shadows in the distant effect, but never near. * * * The horizontal lines cast by clouds on the sea are *not* shadows, but reflections.' It is difficult to say whether this passage betrays more ignorance of fact, confidence of assertion, or confusion of language. Mr. Ruskin appears not to know what shadow is. Whenever the rays of the sun are intercepted by an opaque substance, all objects beyond that substance would be in total darkness, were it not that they become partially illuminated by the surrounding objects. Shadow is simply a deprivation of the *direct* rays of the sun; and to assert that water receives no shadow is either an absurdity or a confusion of terms. If a cloud, a rock, or the hull of a ship is interposed between the sun and the surface of the water, the water receives the shadow; or, to speak with more accuracy, it does not receive the *direct* rays of the sun. Now let us examine what effect is produced upon the eye of the spectator by the deprivation of light on the surface of the water. If the water were as transparent as the air on its surface, the eye would be unconscious of its existence; the ray of light which defines the edge of the shadow would pass through the water as it passes through the air, and the shadow of the object would be seen at the bottom in the same way, allowance being made for refraction, as if there was no water at all. Such absolute transparency is, however, never found in Nature. There is always practically *some* shadow on the surface of the water, the degree of the intensity of that shadow being dependent on several circumstances, but mainly on the degree of the transparency of the water. The reader may test this for himself by a very simple experiment. Let him take a wash-hand basin half full of clear water, and placed in bright sunshine, then let him hold a pencil or brush so that the shadow shall fall partly on the side of the basin, above the water, and partly on the water; he will see the shadow at the bottom of the basin refracted at the point where it impinges on the water, but he will not be able to detect any perceptible shadow on the surface of the water. Then let him darken the water with a little sepia; he will now see at the edge of the water two shadows, one on the surface of the water, the other on the basin, seen imperfectly through the semi-transparent water."

Now, on reading the preceding passage, an attentive reader will be struck by observing the very singular circumstance that the experiment which it suggests, instead of *contradicting* Mr. Ruskin's assertion, is the identical one which might have been appealed to by him as an *illustration* of it, as showing the absence of shadow on clear water, and its presence on water with colouring matter suspended in it. The critic had said that "there is always practically *some* shadow on the surface," and yet, in his own account of his own experiment, he says that the observer "*will not be able to detect* any *perceptible* shadow upon it." Now we must confess that an *imperceptible* shadow, a shadow which we cannot *detect*, is a thing which *we* have never seen, though a theoretical shadow there may be. The critic's own words clearly justify Mr. Ruskin, so far as this account of the experiment goes, especially in a pictorial point of view. A painter is not bound to represent all that he *does* see, still less to represent what he can *not* perceive. He has also, on the principal point, expressed himself erroneously. As regards the present subject of inquiry, and the idea of shadow as generally conceived, "shadow is" *not* "simply a deprivation of the direct rays of the sun." The assertion that it is, is one of those half-truths which, for want of their complements, are *not* truths. We never speak of shadows on a gray day, when the sky is uniformly covered with clouds, and the direct rays of the sun are not perceived at all. *Shadow is the comparative darkness of spaces not illuminated by the direct rays of the sun, or by some other source of light, in contrast with those which are so illuminated;* and, to meet the general idea, perhaps the further limitation is required of *a defined, or nearly defined, boundary, determined by the form and relative position of the object intercepting the rays of light,* since a transition from the illuminated to the darkened spaces, by imperceptible gradations extending over a large space, scarcely realizes the ordinary idea of *shadow,* though it may leave the idea of *shade.*

The truth is, that if Mr. Ruskin had added to his limitation of "clear" water that of "perfectly smooth" water, and the condition "under ordinary circumstances," he would have been practically right; though neither he nor his critic appears to have had the least idea of the simple circumstance on which the (negative) phenomenon of no shadow, or no perceptible shadow, depends. Look at the footpavement running along the side of the street. Why do you, in any position, see the shadow of the lamp-post upon it? Because the direct rays of the sun, falling upon the pavement, except where they are intercepted by the lamp-post, are, by its rough and granular surface, reflected *in all directions*, so that, wherever you are placed, you receive a portion of the illuminating rays from the whole surface of the pavement, except that part from which they are cut off, and thus have the direct contrast of light and shade. Now convert the pavement into a perfectly smooth and clear stream, and the lamp-post into the stump of a tree; if the water is shallow enough, you will see the shadow on the bottom; if not, you will most probably see *no* shadow. The reason of the difference is, that there is now *no diffused sunshine*, such as there was upon the pavement; the smooth surface, instead of reflecting broken light in all directions, acts as a mirror, and reflects only in a vertical plane, and in that plane only to an eye so placed that the angle of reflection from the surface of the water to the eye shall be the same as the angle of incidence of the rays of light upon that surface. If you are on the same side of the water as the sun, you will see *no* sunshine reflected from it; if you are on the opposite side, and in the particular position referred to, you will see, not the sunshine spread over the general surface, which the pavement gave you, but the *image of the sun's disk* in one particular spot. The general surface still receives the rays of the sun, except where they are intercepted (the sun being supposed low enough in the sky) by the stump of the tree; but *for you* they are received only at the one spot which reflects them *to* you, and the space from which they are really intercepted being illuminated equally with the general surface by the light reflected from the atmosphere, the contrast on which shadow depends does not arise, *unless* it should prove to do so on the one condition which, perhaps, may now present itself to the reader's mind; for, though the *supposition* that water does not take shadow is thus accounted for, the rigorous question yet remains, "Does it or not?" We think we can affirm positively that it *does*, and that, too, in a high degree of perfection. After several unsatisfactory attempts to decide the question, it was first decided for us experimentally, and we should have said accidentally, if we had not been reflecting on the subject at the time, and thus noticed what would otherwise have escaped attention. Walking along the road one evening, we suddenly observed the image of the sun's disk reflected on the surface of a pond at some distance, cut into two by a vertical black band, which we saw was occasioned by a stake upon the further bank. Now this appearance could not arise from reflection at the bottom; it was too well defined, and the obliquity of incidence was too great, for that. It was too well defined, also, for reflection from opaque matter suspended in the water, even supposing it not clear, as the water of ponds almost always is, when not recently disturbed by the feet of cattle; and it could not be mere reflection from the surface, because Mr. Ruskin is practically right also in saying, that from the strongly illuminated surface of water there is no reflection. The dark band could, therefore, be nothing else than true shadow, occasioned by the stake intercepting the rays from a vertical section of the sun's disk, and leaving a corresponding portion of its image, illumined by light reflected from the atmosphere alone, in immediate contrast with the intense light covering the remainder of the small circular space occupied by the image of the sun, true and strong shadow, in the strictest sense of the word, being thus produced just there, and there only, where it would be most likely to be missed. This, in fact, *might* have been determined *à priori* as a necessary result of the circumstances stated, dependent, however, on yet one condition, having reference to the diameter of the object, which in this case occurred. If the apparent diameter is greater than that of the sun, and their axes are in the same vertical plane with the observer's eye, of course the case does not arise, the image of the sun not being formed at all on the spot where alone *he* could see it; and if the diameter be too small, the rays proceeding from the more distant portions of the sun, to the right and left, will cross between the object casting the shadow and the water, obliterating the shadow, or leaving only an *imperceptible* penumbra:—another point of difficulty, or at least of delicacy, in these observations, and one which, I think, would vitiate the experiment with the wash-hand basin and the pencil; though, if the stake or the pencil were *in* the water, a small spot of shadow, gradually softened off by penumbra, would probably be seen, especially if the object instead of being round were square, close under the object at the point of contact with the surface. I apprehend that, in conformity with Mr. Ruskin's last-mentioned law, on the space simultaneously darkened by shadow, there would be reflection also; which reflection, however, in the particular case described, would be merged in the shadow. I have since verified these results with the sun higher in the sky, which occasions greater difficulty; and when the surface of the object—suppose the trunk of a tree—has been well illuminated by reflected light, I have seen it reflected from the darkened space; the shadow and the reflection being here *coincident*, though not coterminous laterally, the reflection being chiefly apparent towards the axis of the shadow, the boundaries of the latter being softened by penumbra, and the reflection becoming fainter with the shadow and disappearing first. This coincidence of shadow involves another refinement in observations of this kind, as the presence of the reflection might lead to the hasty conclusion that the appearance was due to it alone. On the whole it appears that water is perfectly capable of receiving and exhibiting strong shadow; but that, as regards shadow in contrast with sunshine, and, in a strict sense, the peculiar conditions are required—that the observer must be opposite to the sun—that he must be in the same vertical plane with it and the object within that plane—that his eye must be at the distance and elevation which make the incidence and reflection equal, so that he may obtain an image of the sun—that a portion of the image must be cut out or cut off by an object interposed between the water and the sun—and that the diameter of the object must lie within certain limits, partly depending upon the distance from it at which the image of the sun is formed to the observer's eye. It follows that no shadow can be formed where the radiant object is a physical point, such as an electric spark or a star, however brilliant the light may be, because its image cannot be divided.

But if the principal point is thus decided, the practical question is not thus exhausted. When we have *rippled* water under sunshine, we have a state of things intermediate between the pavement and the smooth stream. We have neither the uniformly diffused sunshine of the former, nor a single and well-defined image as in the latter case, but a multitude of broken images of the sun. Mr. Ruskin's critic, in a passage subsequent to the one already quoted, asserts "that the reflection of any object must always be in a direct line between that object and his own eye." This is by no means true. As to "a direct line," that is out of the question in such a relative position of the observer, the line proceeding from the object to the eye necessarily changing its direction at the point of reflection. What the writer meant, as evident from the context, was a vertical plane. But neither is this true. On rippled water—and he is referring to the sea—innumerable reflections of the sun, or portions of it, and similarly of other objects, or portions of them, may reach the eye in directions depending on the inclination of the ripples, or of the wavelets upon them, and in oblique as well as vertical planes. In this case objects of sufficient size, and placed in such a position as to intercept the sun's rays and shade the ripples, will necessarily produce shadow, in a modified sense, by depriving the waves within the shaded spaces of their sparkle, whilst those around retain it. This may be seen any fine day when there is a brisk wind. We particularly remember noticing it upon Lake Idwal, North Wales, under a glorious sun. Almost every wave appeared at some point to reflect the sun, and the whole surface of the lake was studded with intensely brilliant spangles occasioned in this way, except under the shade of the mountain on the opposite side. At some distance the shadows of objects of considerable size may thus be seen pretty well defined; and as the waves are in constant motion, and every instant changing the direction of their reflecting planes, the observer may perceive them in positions of the eye indefinitely varied. We are persuaded that it is only in this way that "shadows," as the critic contends, but which Mr. Ruskin designates as "something like shadows," are to be seen upon the sea; that is to say, that they are only to be seen upon it, supposing the water clear, as troubled water; and we think it very probable that such shadows, though perceptible at a distance, may disappear, as the last-named writer affirms they do, where we might expect to enter them. Admitting the shadow of clouds in this modified sense, we think Mr. Ruskin's indefinite ideas of lights and shades and colours upon the sea, derived as they are from shadows, reflections from the surface, from bottom rocks, from sands, shingle, sea-weed, or sand or mud suspended in the water, will better correspond with the appearances which present themselves to the observer's eye as he stands on the cliffs on a bright and breezy day at Scarbc·ough, than the sharp and clear distinction between clouds and shadows which his critic thinks can be so easily drawn.

There is yet another case in which we can have no doubt that shadow may be seen on water, though not in contrast with sunshine. We must, in connection with this case, revert to Mr. Ruskin's observation that reflections do not take place from an illuminated surface of water. We believe, as we have already said, that in this case also he is practically, or optically, right, though we cannot doubt that he is theoretically and physically wrong; since we cannot suppose that there is anything in the fact of such a surface being illuminated that can deprive it of its property as a mirror. We feel quite satisfied that the surface which seems to refuse reflections to an observer *who receives* the illumination, even the very spot which reflects to him the image of the sun, would grant them to him on the opposite side of the water, where he does *not* receive the illumination. The illumination itself is, in truth, nothing but *the reflection of the source of light;* and the fact observed by Mr. Ruskin is undoubtedly owing to the feebler rays proceeding from other objects, though just as strongly reflected as from shaded water, being overpowered by the stronger rays proceeding from the source of light, and reflected with them to the eye. This, of course, will be most eminently the case when the reflected light is the actual disk of the sun, which must completely destroy the sense of all other reflections, the apparent absence of which is only a physiological, sensational, or optical result, not a physical one. Now, remembering that the illumination of water is only its reflection of the source of light, suppose an observer to stand on the eastern side of a sheet of water, after sunset, when there is a zone of strong light on the western horizon—a light distance, as Mr. Ruskin would call it—not overtopping, to the observer's eye, a building such as a tower or castle, on the western side of the water and close to it, the rest of the sky being covered with clouds; it is evident that this zone of light would be reflected from that part of the water which the light can reach, and not from that from which it is intercepted by the tower, and the latter space must certainly be considered as receiving shadow, at least within our larger definition; though the light proceeding from the more distant portion of the zone, and partially entering the shadow, might be found to reduce its external portion to a penumbra, only so gradually deepening that it may be impossible to draw a line of demarcation strictly determining the extent of the shadow and giving it a nearly defined outline, so as to bring it within the further limitation suggested as requisite to the proper description of shadow as generally conceived. The shadow should be most apparent close to the angle of the tower, and just beneath it. Flame should cast a shadow in the same way, either directly, if sufficiently extensive, or by limited reflection from the sky.

In the account we have thus given of the matter—any mistake in which we should be glad to have corrected—it will be observed that we have not taken any notice of the transparency of clear water as accounting for the ordinary absence of shadow. The effect of this transparency is to reduce the lustre of reflections by allowing a portion of the incident light to enter the water—at large angles of incidence much the larger portion; but this does not affect the essential conditions of the problem, which depend not upon the *quantity* of reflected light but on the *mode* in which it is reflected.

Having mentioned Rydal Water, we cannot refrain from adverting, in conclusion, and in close connection with our subject, to the extreme perfection and beauty of the reflections which are sometimes formed on this lovely little sheet of water and the adjacent one of Grasmere. Doubtless they are formed, and we may have seen them, on other lakes in the midst of mountains, in equal perfection; but it is here chiefly that we have observed them, and the small size of the lakes may contribute to produce a perfect calm more frequently than it occurs on larger ones. Standing on the western side of the water, with the setting sun illuminating the scarped face of the mountain opposite, we have often seen the lake (except for a few yards from the margin, where we could see the bottom) so completely covered with the images of objects on the other side—no light, therefore, from the sky (an important condition) being re-reflected by the water to the eye—that the lake itself has been invisible; those images, at the same time, being so strong and vivid as not to be distinguishable from the objects themselves, or allow the opposite boundary of the lake to be discernible, otherwise than by observing where the trees appeared to grow root to root, and where, extending downwards, the images betrayed, by their inversion only, that they were not themselves objects similar to those which they represented. At small angles of incidence* water reflects from two-thirds to three-fourths of the rays which fall upon it—about the same proportion as a mirror of plate-glass—and as the surface of an absolutely perfect mirror would be quite invisible, that copiousness of reflection, combined with the accurate definition of images on the smooth surface of still water, accounts for the beautiful effects which are thus produced. If those of our younger readers, who have the privilege of travelling occasionally amidst the lovelier scenes of Nature, will cultivate the habit—which should not be neglected in its homelier scenes—of closely observing the varied appearances of Nature, and endeavouring to account for them, they will find an additional charm and interest given to these delightful wanderings, and a higher improvement will be derived from them.—"*Felix qui potuit rerum cognoscere causas.*"

J. N. K.

* The angles of incidence are referred to as measured from the *surface*.

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METEOROLOGY OF OCTOBER.

FROM OBSERVATIONS AT HIGHFIELD HOUSE OBSERVATORY.

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Year.	Mean Temperature of the Air. Degrees.	Mean Temperature of the Dew Point. Degrees.	Mean Pressure of the Air. Inches.	Mean Amount of Cloud. (0—10).	Number of Rainy Days.
1846	49·5	45·8	29·399	6·4	16
1847	53·1	47·5	29·831	8·3	11
1848	50·8	46·3	29·676	6·9	25
1849	45·8	43·1	29·734	5 9	19
1850	46·3	41·4	29·690	6·3	20
1851	50·5	46·7	29 712	7 3	22
1852	46·0	40·8	29·702	6·6	17
1853	48·8	43·7	29 535	8 0	20
1854	47·6	39·8	29·680	5 9	17
1855	48·6	43·6	29·465	7·3	22
1856	50·8	46·9	29·983	7 8	15
1857	52·1	48 1	29·682	8 1	17
1858	49·4	44·0	29·813	8 0	14
1859	48·4	42·5	29 502	7 0	11
Mean	49·1	44·3	29 672	7·1	18

The mean temperature of the last fourteen years for October is 49·1°, the range in the mean temperature being from 45·8° in 1849 to 53·1° in 1847—a difference of 7·3°. The lowest means occurred in 1849, 1850, 1852, and 1854; and the highest in 1847, 1848, 1851, 1856, and 1857.

The mean temperature of the dew-point of the past fourteen years for October is 44·3°, the range being from 39·8° in 1854 to 48·1° in 1857—a difference of 8·3°; the lowest means occurring in 1850, 1852, and 1854, and the highest in 1847, 1848, 1851, 1856 and 1857. The difference between the mean temperature and that of the dew-point was as much as 7·8° in 1854, and as little as 2·7° in 1849—a difference of 5·1°; the mean difference between the temperature of the air and that of the dew-point being 4·8°.

The mean pressure of the last fourteen years, for October, is 29·672 inches, at 174 feet above the mean sea-level, ranging between 29·399 inches in 1846, and 29·983 inches in 1856—a difference of 0·584 of an inch. To reduce these readings to the sea-level, it is requisite to add 0·188 of an inch, when the mean temperature is as low as 45·8°, as in 1849, and 0·185 of an inch when it is as high as 53·1°, as in 1847; thus the mean pressure, reduced to the sea-level, for the past fourteen years for October is 29·858 inches.

The mean amount of cloud for October of the last fourteen years is 7·1, ranging between 5·9 in 1849 and 1854, and 8·3 in 1847—a difference of a quarter of the whole sky.

The mean number of rainy days for October in the last fourteen years is 18, ranging between 11 in 1847 and 1859, and 25 in 1848—a difference of 14 days. The mean number of rainy days is 6 greater than in September. The years of but little rain being 1847 and 1849, and of much rain, 1848, 1851, and 1855.

E. J. Lowe.

ASTRONOMICAL OBSERVATIONS FOR OCTOBER, 1860.

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The Sun is in the constellation Libra till the 23rd, and then in Scorpio, being now south of the equator. He rises in London on the 1st at 6h. 3m., on the 10th at 6h. 18m., on the 20th at 6h. 35m., and on the 30th at 6h. 52m. He sets in London on the 1st at 5h. 36m., on the 10th at 5h. 16m., on the 20th at 4h. 54m., and on the 30th at 4h. 34m. He rises in Dublin on the 11th three minutes later, and on the 22nd six minutes later than in London; and sets at Dublin on the 12th six minutes earlier, and on the 23rd six minutes earlier than in London. At Edinburgh he rises on the 7th six minutes later, and on the 20th thirteen minutes later than in London; and sets on the 8th eight minutes earlier, and on the 21st twelve minutes earlier than in London. At the close of the month there is half an hour's less sun at Edinburgh than in London.

The Sun reaches the meridian on the 1st at 11h. 49m. 32s. a.m.; on the 10th at 11h. 46m. 56s.; on the 20th at 11h. 44m. 49s.; and on the 30th at 11h. 43m. 46s.

The Equation of Time on the 1st is 10m. 28s.; on the 10th, 13m. 4s.; on the 20th, 15m. 11s.; and on the 30th, 16m. 14s. after the Sun (subtractive).

Day breaks on the 2nd at 4h. 10m., and on the 30th at 4h. 56m.

Twilight ends on the 3rd at 7h. 25m., and on the 31st at 6h. 28m.

Length of day on the 9th, 11h. 2m.; and on the 24th, 10h. 4m.

Length of night on the 26th, 14h. 3m.

New Moon on the 14th at 2h. 37m. p.m.

The Moon is full on the 29th at 6h. 49m. p.m.

The Moon is at her least distance from the Earth on the 13th, and at her greatest distance on the 26th.

Mercury is favourably situated for observation at the end of the month in the afternoon. He is in the constellation Virgo at the commencement of the month, then in Libra, and at the end of the month in Scorpio. He is slightly west of δ Scorpii on the morning of the 30th, rising on the 3rd at 6h. 53m. a.m., on the 13th at 7h. 49m. a.m., and on the 23rd at 8h. 39m.; setting on the 3rd at 5h. 48m. p.m., on the 13th at 5h. 30m., on the 23rd at 5h. 17m., and on the 28th at 5h. 11m. p.m.

Venus is in Leo at the beginning, and in Virgo at the close of the month. She is a morning star, and a very brilliant object. She is of the form of a half-moon at the commencement of the month, rising on the 3rd at 1h. 47m. a.m., on the 13th at 2h. 4m., and on the 23rd at 2h. 26m.; setting on the 3rd at 4h. 5m. p.m., on the 13th at 3h. 52m., and on the 23rd at 3h. 36m. p.m.

Mars is a conspicuous object, although smaller than two months ago. He is in the constellation of Capricornus; rising on the 3rd at 3h. 34m. p.m., on the 13th at 3h. 4m., and on the 23rd at 2h. 34m.;

setting on the 3rd at 11h. 24m. p.m., on the 13th at 11h. 16m., and on the 23rd at 11h. 12m. p.m.

Jupiter is in Leo. He rises on the 3rd at 1h. 16m. a.m., on the 13th at 12h. 47m. a.m., and on the 23rd at 12h. 15m. a.m.; setting on the 3rd at 4h. 7m. p.m., on the 13th at 3h. 32m. p.m., and on the 23rd at 2h. 56m. p.m.

Saturn is also in Leo. He rises on the 3rd at 2h. 37m. a.m., on the 13th at 2h. 4m., and on the 23rd at 1h. 29m. a.m.; setting on the 3rd at 4h. 40m. p.m., on the 13th at 4h. 4m., and on the 23rd at 3h. 26m. p.m.

Uranus is favourably situated for observation. He is still in the constellation Taurus, rising on the 3rd at 7h. 43m. p.m., on the 13th at 7h. 3m., and on the 23rd at 6h. 22m. p.m.; setting on the 3rd at 12h. 1m. p.m., on the 13th at 11h. 21m a.m., and on the 23rd at 4h. 40m. a.m.

Eclipses of Jupiter's Moons.—On the 1st, at 2h. 44m. 23s. a.m., the 1st moon disappears; on the 24th, at 2h. 52m. 57s. a.m., the 1st moon disappears; on the 29th, at 2h. 20m. 26s. a.m., the 2nd moon disappears.

There is only one Occultation of a Star by the Moon larger than of the 6th magnitude, viz., on the 2nd, at 12h. 0m. mean time, when the immersion of μ Arietis takes place.

The variable star Algol will in the evening attain its *least light* on the 15th, at 9h. 55m., and on the 18th at 6h. 44m.

Stars on the Meridian.—On the 15th, α Pegasi, at 9h. 19m. 23s. p.m.; on the 16th, α Arietis, at 12h. 20m. 24s. a.m.; on the 20th, α Andromidæ, at 10h. 2m. 55s. p.m.; on the 22nd, β Arietis, at 11h 40m. 32s. p.m.; on the 23rd, β Ceti, at 10h. 26m 26s. p.m.; on the 27th, α Pegasi, at 8h. 32m. 12s. p.m.; on the 31st, γ Pegasi, at 0h. 24m. 32s. p.m.

E. J. Lowe.

THE EXTRAORDINARY WEATHER OF AUGUST, 1860.

The following brief record of this remarkable month will prove interesting to the subscribers of Recreative Science. The great amount of rain, the number of rainy days, the great amount of ozone, the very small amount of evaporation, and the very low temperature, have made August, 1860, a month perhaps without a parallel.

On referring to page 36, vol. i., of Recreative Science, it will be seen that the temperature in 1856 rose to 92·5° in the shade, and that between 1842 and 1858 it always exceeded 74°, the lowest year being 1845, viz., 74·5°, and that the average amount of rain was 3 inches, the greatest amount falling in 1857, viz., 6½ inches, and the least in 1850, viz., 1 inch. Again, on referring to page 102 of the same work, it will be seen that the mean temperature of August is 60·9°, the range being from 57·6° in 1848 and 1853 to 65·8° in 1846; that the mean number of rainy days is 16, ranging between 10 and 25; and that the mean amount of cloud is 6·4.

Let us now compare the above with that of August, 1860:—

The greatest heat attained was only 73·0°, or 1° colder than the coldest August recorded here, and 19·5° colder than in 1856. It is worthy of remark that the temperature only reached 70° on two days, and on two other days it did not exceed 57·5°, or 35·0° lower than in 1856. The mean temperature of August, 1860, was only 56 8°, or 4·1° below the average, being three-quarters of a degree colder than the coldest August recorded here, and 8·5° lower than that of 1846. On the 24th of August the mean temperature was only 51·6°, lower than ever recorded here in this month, and 13·7° lower than the mean temperature of August, 1846.

The amount of rain in the past August was 6·276 inches on the ground, and 5·563 inches at 25 feet above the ground, the excess over the mean being 3¼ inches, the amount being slightly below that of August, 1857; but in August, 1857, above 3 inches fell during a thunder-storm on one morning (the 13th), and an inch fell on another day, whilst in 1860 there was no day on which an inch fell.

The number of rain days in August, 1860, was 31, rain having fallen every day, or 15 days more than the average. In this, August, 1860, differs considerably from August, 1857, for in that month rain only fell on 10 days in 1857.

The sky was covered with cloud to the extent of above eight-tenths of the whole sky (8·2), or two-tenths above the average for August.

As the year 1859 is not included in the above means, a comparison will illustrate the character of the two years.

	1859.	1860.	
Mean temperature of August. . .	61·7	56·8	4·9° lower than last year.
Maximum heat in shade	86·0	73·0	13° lower than last year.
Greatest cold . . .	44·0	43·5	0·5° lower than last year.
Amount of cloud . .	6·0	8 2	2·2° above last year.
Amount of evaporation	6 197	3·001	3·196 inches less than last year.
Number of rainy days	14	31	17 days more than last year.
Amount of rain at 25 feet	2·979	5 563	2·586 inches more than last year.
Amount of ozone in the night . . .	1·4	6·7	5·3° above last year.
Amount of ozone in the day . . .	0 7	6·7	6·0° above last year.
Rain in night . . .	1·709	2·922	1·213 inches above last year.
Rain in day. . . .	1·270	2 641	1·371 inches above last year.

Thus August, 1860, is shown to have been very cold, remarkably rainy and cloudy, and with only half the usual amount of evaporation; indeed, in 1859 the amount of evaporation exceeded the rain-fall in August by 3·218 inches, whilst in 1860 the rain-fall *exceeded the evaporation* by 2·562 inches—a difference between the two years amounting to 5·780 inches; we have, therefore, not only had a great increase of rain, but this water has not again been evaporated and carried into the air. E. J. Lowe.

Highfield House Observatory, Sept. 4, 1860.

THE MICROSCOPIC OBSERVER. OCTOBER.

Aquatic Larvæ.—As the season is fast declining, observations not yet completed on aquatic larvæ should be proceeded with at once, and desiderata for cabinets and collections of mounted objects procured. In our drainage wells we have still myriads of the larvæ of *Culex pipiens*, and as there is a probability of warm weather being prolonged into the autumn, successive broods may be continued till late in the year. We have also larvæ of *Dyticus marginalis*, *Gyrinus natator*, and *Phryganea* in abundance. The readiest way of collecting these is by means of a hand-net lined with muslin, and they should be transferred at once to vessels of water for preservation until required for observation. In this class of subjects the development of the respiratory organs will first attract attention, and the transparency of their bodies, allowing of a consecutive examination of the dorsal vessels, the circulation and the disposition of the tissues, they furnish abundant material for the study of animal physiology. This is a good season (though late) for the study of these subjects, because the perfect insects can be obtained along with eggs, larvæ, and pupæ, so as to show at once their several stages of progress from the ova to the imago form. *Culex pipiens*, though one of the most common of its class, should first be selected because it is the type of the interesting family of *Diptera* denominated *Culicidæ*. The boat-shaped masses of eggs have often been described as an example of insect naval architecture. The larvæ are agile and interesting creatures when kept in tall jars of clear water in a window for observation. The points for observation are the antennæ, two in number, without joints, the ciliated appendages, the feathery hairs on the thorax, the ten segments of the abdomen, the respiratory tube, articulated to the eighth joint, the star-like termination of the tube, the setæ on the last joint of the abdomen, and the five conical plates. The successive moultings are to be watched for during the progress of the larva to the pupa form. The pupæ are locomotive, but take no food, and instead of suspending themselves tail upward, as is the case with the larvæ, they reverse the position, and continue head upward till finally transformed. Now the respiration is performed by means of the air-tubes on the thorax. When the transformation takes place, the exuviæ serve as floats on which the winged insects complete the expansion of their wings. The *Culicidæ* in their imago forms may be distinguished by the elongated proboscis thickened at the tip. This in the female consists of seven pieces, and is admirably represented in pl. 26, fig. 30 and 31 *e*, of the "Micrographic Dictionary." The antennæ are filiform and 14-jointed, plumose in the males only. The proboscis of the female should be made a subject of separate and careful study for the detection of the labrum, the maxillæ, or basal terminations of the palpi, the lanceolate tongue, and the sheathing labium. The males are destitute of the labrum and tongue. Among the many subjects that come before the collector of aquatic objects, the gnat affords perhaps the most instructive, as well as most agreeable, sources of recreative study. When the perfect insects escape by myriads from the water, they assemble on the windows, and keep up a music of the most pleasing kind by the rapid vibration of their transparent wings. This vibration is at the rate of about 3000 strokes per minute. Next to *Culex pipiens*, *Chironomus plumosus* claims the attention of the microscopic observer because of the uniqueness of its transformations, and the absence of a description of it in the "Micrographic Dictionary" is an omission to be regretted. The larvæ are commonly known as blood-worms, and their economy resembles pretty closely that of their congeners. This also should be kept in vessels for observation, and the leading points of interest in its history are the breathing organs, and the distinct joints of the abdomen, the plumed spiracles of the pupæ, and the elegantly-plumed antennæ of the perfect insect, by means of which it is so easily distinguished. Kirby's description of this insect and its transformations is most complete and interesting, especially his solution of the difficulty as to how the pupa becomes suspended with a part of the body above water, though specifically heavier than water.

Gasteromycetes.—In damp woods, and among rockeries and rockwork in gardens, examples of gasteromycetous fungi are far from uncommon at this season of the year, though less seasonal in their appearance than most other divisions of this great section of *Cryptogams*. They give peculiar stains to dead twigs, decaying leaves, rotten wood, and other vegetable substances in the early stages of decomposition, and they also appear as underground fungi, their mycelium attacking the roots of trees. The *Gasteromycetes* produce free spores, in groups of fours, on the convoluted hymenium in the interior of the fungus, which finally bursts and distributes them. The mycelium is filmy and inconspicuous. There are six recognized families in the order, five of which are British, and the species easily obtainable. The *Podaxinei* is the only exotic family of the order, and their leading characteristic is found in the solid column in the centre of the sporange. The *Hypogei* are in their organic development somewhat akin to the truffles, being wholly underground in growth, and their mycelium probably very destructive there to the roots of trees. The basidia spores occur in the cavities of the indehiscent receptacle; they appear as globular balls, sessile on the mycelium. The spores are set free by the decay of the fruit, and they speedily attach themselves to the underground bark of the roots of the tree, and extend by ramifications of the flocculent mycelium. The *Phalloidei* have a dehiscent peridium, which bursts, and sets free a sporiferous mass, which is columnar, or a spherical reticulation of fleshy substance coated with an offensive mucilaginous mucus, in which spores are embedded. The fructification is sometimes mistaken for mycelium, but the error is one soon detected by the microscopist. *Trichogastres*, or puff-balls, are an interesting family, on account of their distinctness. The fruit is usually globular and leathery, arising from an inconspicuous silky mycelium, but in some cases the sporanges occur in masses in a fleshy matrix. The sporiferous mass disperses in the form of dust without a central column. The peridium, or leathery membrane inclosing the internal convoluted portions, is in some cases single, in others double. In some the peridium is prolonged into septa, which divide the interior into two chambers, each of which contains a conceptacle with filaments bearing basidia. *Lycoperdon* is a common genus, which in its fructification exhibits some remarkable characteristics, especially when the peridium bursts. *Myxogastres* are minute fungi, which have the appearance of froth, and may be met with at almost any season of the year, among heaps of dead leaves and garden sweepings. When the frothy mass dries up there is left behind sessile or stalked capsules, which consist of a double peridium. These burst and emit the spores, which rise and germinate, and reproduce the original frothy mass. A very pretty example of *Myxogastres* is Cribaria, of which there are only three described British species. They may be recognized by their appearance on rotten wood as stalked globular bodies, which stud the surface profusely wherever they appear. The globes are about half the size of an ordinary pin's head, the colour yellowish, and the stalk white. The spores are produced abundantly among anastomosing filaments, from the meshes of which they escape. This last-named process is admirably figured at page 188 of the "Micrographic Dictionary," fig. 147. The *Nidulariacea* take their name from the resemblance to a nest containing eggs which the conceptacles bear when exposed in the cup-shaped peridium. These conceptacles are lined with basidia. The mycelium may be commonly met with in decayed dung, in cucumber-frames, and in bins of dung under cover in every gardener's potting-shed. *Cyathus striatus* and *vernicosus* and *Crucibulum vulgare* are the species most commonly distributed.

Seaside Studies: Sponges.—Several papers on sponges having appeared in the pages of Recreative Science, visitors at the seaside who have read those papers may find the opportunity of confirming, by microscopic observation, many of the principles laid down in regard to their physiological structure. They may be looked for under stones at low-water mark when the tide is out, on masses of fucus washed up from deep water, and on the walls of caves that are below high tide-mark. The ciliary currents, the spicules, and the pores have been described in detail in the several papers just referred to. The *Poriphora* are always fixed, and consist of flinty or calcareous spicula, ramifying over which is a coating of gelatinous granules, through which regular currents are kept up by the action of the cilia. *Tethea* has two species, cranium and lyncurium. The spicula are arranged in bundles radiating from a central nucleus; the interior is fleshy, the exterior mass solid, and covered with a skin. *Halichondria* is a large genus, admirably tabulated in Mr. Gosse's "Manual of Marine Zoology." *H. palmata* is the finest of all the British sponges, and is known on the coast as the "mermaid's glove." Its appearance is sponge-like, and its size is often considerable. From the base it breaks into a series of finger-like divisions, along which the oscula are very prominent. The texture is fibrous, and the spicules are imbedded. *H. panicea* is a very common species, and may be sought between tide-marks on the fronds of *Fuci*, in empty shells, and on *Corallina officinalis*. It is admirably figured at page 6 of this volume; from that figure the sponge-hunter will be enabled to recognize it when met with. On *Sertularia* and on *Fuci* will often be found examples of *H. fucorum*. It is arborescent in its divisions, and the spicula are knobbed at one end. *Cliona* will generally be met with in dredging as an inhabitant of empty shells, which are lined with its yellow, fleshy substance. Sometimes shells still inhabited by molluscs are lined with masses of this sponge, which prepares for itself a nidus by excavating cavities. This operation is accomplished by means of the crystalline granules of flint which cover the surface of the sponge, and which act on the shell by presenting numerous cutting points and angles. Stones are also frequently mined by it, and circular holes formed, through which the *Cliona* protrudes its mouths. *Halisarcha* and *Grantia* are kinds also pretty freely distributed, and if *Grantia nivea*, which is snowy white, is met with, it must be considered a prize. *Halisarcha* forms a thin crust on rocks and shells, and is entirely without spicula. It is common enough on the stems of *Laminaria*, and bears the appropriate name of "sea-flesh" among habitues of the coast. *Spongia limbata*, also commonly met with on *Corallines*, is a purse-shaped mass, porous and elastic, the net-work formed of horny threads. Any of these, and others met with between tide-marks, may be preserved for a considerable time in a small Warrington tank, with a cover of blue glass to subdue the light if placed in a window; many of them dry well, but lose their colour.

Objects worth Seeking.—At this season most fruits are in the best condition for microscopic study. Fruit-stones should be reduced to sections of but one layer of cells for the study of secondary deposits. Among plants in flower, the Hypericum presents interesting examples of the structure of stamens and pollen-cells. Sections of dicotyledonous stems show at this season more definitely than at other times the ring of woody structure last formed. The ducts grouped near the inner part of the consecutive layers are well exhibited in the oak. In the conifers there are no ducts. Chrysalids of butterflies and moths may be found in plenty under the bark of old trees, in crannies of walls, and on the under sides of leaves. The enveloping membranes of the various species exhibit distinctions of structure and markings worthy of careful observation. The common mussel, which usually comes to market at this time of year, is an object of interest, on account of the Diatoms usually to be found in the alimentary canal. To obtain the silicated valves of the Diatoms, dissolve the mussel (removed from the shell) in hot nitric acid, and wash the residue, on the plan described by Mr. Tuffen West in his papers in the first volume. Ciliary motion is admirably exemplified in the gills of the common mussel. The spores of ferns may still be gathered in good condition for the microscope, and most of the subjects described in the lists for August and September are still in condition for examination. Mosses and lichens have commenced their seasonal growth, but they are not yet generally in fructification.

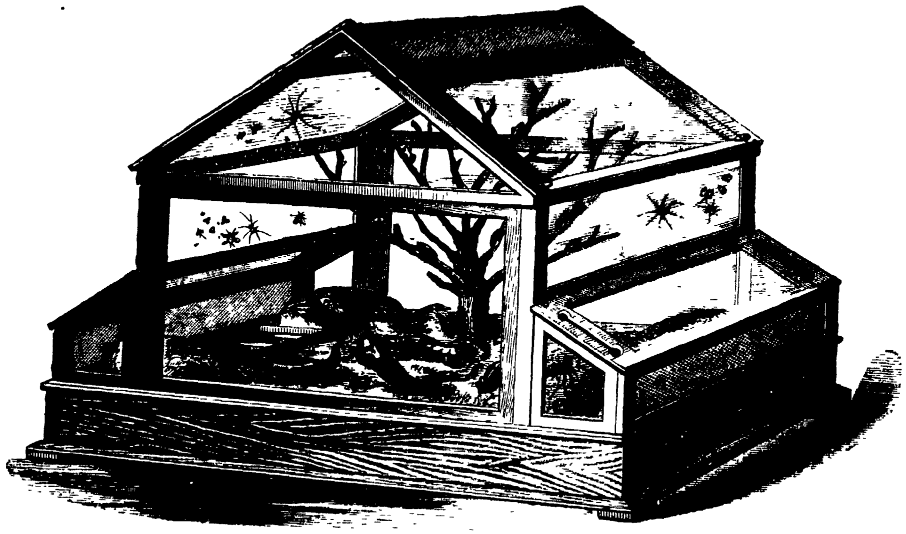
Mr Noteworthy's Corner.

Photographic Poisons.—Mr. Noteworthy tenders thanks for himself and friends to Mr. Samuel Highley, F.G.S., F.C.S., etc., for his valuable Table of Antidotes to the Poisonous Bodies used in Photography. Many accidents have occurred among photographers, and more than once the coroner has had to decide upon them. In this table are entered twenty-one poisons; the dangerous, very dangerous, and most dangerous being severally distinguished by typographical marks. Opposite each is a description of symptoms, and in the next column a short statement of the proper treatment for nullifying the effects of the poison. Mr. Highley rightly says:—"Send a messenger without a moment's delay for the nearest medical man," but as poisons will not always wait for medical men, every photographer should be prepared for emergencies. The Table was originally published in the "British Journal of Photography," and is now reprinted for suspension wherever photography is practised.

Rainfall.—Mr. Noteworthy fell into an error in citing Colonel Austen's calculation, given at page 101 The fall of rain per acre last year was 3111 *tuns measure*, and a fall of one inch represents 90 *tuns measure* on an acre of ground.

Preparation of Foraminifera for the Microscope.—Some of Mr. Noteworthy's friends, who have been set to work on *Foraminifera* through the perusal of Mr. Mackie's and Mr. Leifchild's papers, are in a difficulty as to the preparation of specimens. There need be no difficulty, and the simplest plan is to scrape the chalk into a watch-glass, in which there is already a little water. As much scraped chalk as would cover the three figures at the corner of this page is sufficient, and it should be diffused through the water, and then be set aside for not more than half a minute. Then remove, while yet in a milky state, nearly all the water with the particles that float in it, and let the sediment get quite dry. This residue is to be moistened with oil of turpentine, and then warmed over a spirit-lamp. Canada balsam is to be added, and the mass is to be digested over the lamp on a piece of tin-plate, or on Smith and Beck's brass-table, but it must not froth during the operation. A power of 300 diameters is necessary for the observation. The study of these organic forms is one of the most agreeable and instructive of any within the range of microscopic practice.

The Age of the Earth.—Mr. Noteworthy has read with more than ordinary delight Mr. S. J. Mackie's "First Traces of Life on the Earth," in which the earliest organic deposits are described, and their chronological and zoological relations to the whole mass of superincumbent strata are pointed out with remarkable clearness, and in a style which gives a colouring of poetry to the hard facts of the subject. Mr. Mackie accepts the theory of internal heat as explanative of many great questions which arise as to the present aspects of the crust of the earth, and thereupon endeavours to construct a scale of geological time which is so suggestive and ingenious that Mr. Noteworthy cannot forbear to quote it here as a nugget from a good mine. He says —Measure off on a roll the successive masses of rock strata, which we know by their super-positions to be true indications of geological time, on a scale of one inch and a-half to a thousand feet of vertical thickness, and your diagram will reach to a length of nearly nine feet. Over the uppermost of these add a segment to represent recent deposits; it will scarcely be the eighth of an inch in thickness, yet four thousand years at least have intervened since the parents of the human race trod the verdant floor of the beauteous Eden Take the next in order, the latest tertiary age—the age of glacial drifts and icebergs—and a quarter of an inch will overlap the segment you have drawn. And yet for thirty thousand years at least the foaming cataract of Niagara has been cutting through the raised and consolidated strata of that vast age;—for vast it must have been when whole species of maritime mollusca migrated many geographical degrees from their ancestral haunts to seek out warmer climes; when whole continental tracts were raised into the regions of perpetual snow. And again, the uplifted lands subsiding to their ancient levels, their shores were once more inhabited by the returned posterity of the outdriven shell-fish. Take the next segment of the rock-formation, and the caves disgorge the bones of hundreds of extinct pachyderms and ruminants. Compute the cubic space of the fleshly bulk of the collective carcasses of those exhumed by inquiring man alone, and their volume far surpasses the capacity of the caves to contain them; and yet for hundreds disinterred, thousands remain behind. Take the next age, and two thousand feet of sediment tell of still more extensive changes, and still more extended time. And the next, and the next, and greater and greater becomes the thickness of the stony volumes of the earth's history, until in the coal measures we have fifteen thousand feet and more of instructing leaves, and in the silurian and the "bottom-rocks" twenty-five thousand and twenty-six thousand feet of evidential records.



Reptile Vivarium.

REPTILE VIVARIA.

Some loud denunciations have been uttered against the introduction to the domestic circle of "things that creep and crawl." I shall incur the hot displeasure of those who assume the task of censors, and who are prepared to pick and choose for other people the subjects of natural history studies. But that will be of no moment whatever; because the disapprobation of the few will be more than balanced by the approval of those genuine students of Nature who refuse to recognize the artificial boundary-line set up by fastidiousness, under the supposed authority of the principles of good taste. I find as much to interest and instruct me in the resources of Infinite Wisdom among the creeping things that date from the fifth day of creation, as among the cattle and beasts of the earth that were established one day later, and all of them were blessed with the same words as "good," and alike ordained to "be fruitful and multiply in the earth." There should, in truth, be no apology for the pursuit of knowledge in any direction among the wonders of creation, and if certain forms of life, from which the unschooled mind shrinks with foolish aversion, attract a certain number who find intellectual recreation in the observation of their habits, that is so much gain to the cause of popular enlightenment and the advancement of true science. I shall not now dwell on the peculiarities of the *reptilia*, in order to advance their claims for reception into the household for living lessons in zoology; suffice it that their anatomical structure, and relations to the orders above and below them, give them a distinct position in the order of animal life, and those are sufficient reasons for grouping together as many as can be obtained of kinds suited to preservation in vivaria.

When I wrote a short account of the green-tree frog (p. 49, vol. i.), I was collecting from various quarters living examples of the Saurian and Ophidian orders of the reptilia, and such of the amphibia as were adapted to domestication. By the summer of this year the collection had grown to larger dimensions than had been anticipated, and above a hundred living specimens were domiciled in my study, without causing alarm to the household or danger to myself. Glass dishes, vases, small Warrington tanks, and other similar receptacles, were pressed into the service, and there was such a chorus of frogs every night as rendered it quite unnecessary to cultivate or desire any other music, though, in truth, we have birds enough to make the house more than vocal during all the hours of daylight. Those who perused the paper on the green tree-frog will remember that, after much trouble, I got possession of three specimens, and that two of them escaped through the bungling way in which the cage was made to which they were committed. In the sequel it proved that, though absent, they were not lost, and a few days after the paper was published news of both reached me, not less to my delight than my surprise. One had made his way into the garden of my neighbour, Mr. Wright, who lives at a distance from here of a quarter of a mile. Mr. Wright captured this strange creature, and when RECREATIVE SCIENCE came to hand he read of my mishap, and knew all about his interesting capture. The other travelled three-quarters of a mile to the garden of Mr. Denny, surgeon to the Dispensary in High Street, Stoke Newington, and he was so taken with the beauty of his visitor, that he had no sooner secured it as a prize than he set to work to construct for it a habitation, and became an ardent cultivator of reptilian zoology. I connect these two fugitive frogs with my own loss, because they were both caught about the time the loss happened; but I did not ask to have them returned, because they *might* have come from elsewhere, and I was not the only possessor of specimens on this side of London. One of the two I lost was a fat female, and the one Mr. Denny caught was a fat female; the other was a full-grown male, and the one Mr. Wright caught was a full-grown male. Coupling these facts with the date of the occurrence, and I think the coincidences suffice to prove the possibility of a tree-frog travelling three-quarters of a mile, in the course of which it would have to cross three or four high roads, and make a tour of an additional furlong, to get to the garden where the capture happened; so, omitting all wanderings out of the way, because we know nothing about them, the fat female made a journey of a mile at least.

Mr. Denny's progress in reptiology commenced with the conversion of a blackbird's cage into a vivarium: the wires were removed, and sheets of glass substituted, the glasses being placed loosely into grooves, and held in their places by wooden buttons. The drawer was lined with zinc to hold water, and a branch of dead laurel placed in the centre made Mrs. Hylas happy as if at home. Reflecting on the loneliness of the separated individuals, I gave Mr. Denny my remaining specimen, a male, and the two celebrated their union by vocal exercises, in which they had not once indulged before. If a lonely tree-frog is a very dumb animal, a company of tree-frogs will be garrulous in the enjoyment of social converse. Meanwhile, my friend Mr. Denny gathered together lizards, tritons, and various specimens of *Ranidæ*, and was so bewitched with the beauties and peculiar antics of his family, that the bird-cage was kicked out, and three handsome cases made for the purpose of classification, and for fully meeting the several requirements of the creatures thus honoured with domicile in the dwelling of a thorough cultivator of zoological science. One of these cases is figured at the head of this paper, and may serve as a model for any of our readers who are in a state of perplexity as to the best contrivance for preserving reptiles. It is a truly beautiful specimen of cabinet-work, and most ingeniously adapted to the purpose for which it was designed.

The structure is made of walnut-wood, and the squares of glass are fitted in frames which lift out, so that access may be obtained at a moment to any part of the interior; and, if necessary, the whole of the glass can be taken away, so as to reduce the wood-work to a skeleton. The engraving will, in a great measure, explain itself. The lower part of the interior consists of a mound of peat planted with various species of mosses, which maintain a healthy verdure all the year round, and form a moist carpet for the playful inhabitants. In the centre is inserted a dead branch, on which the treè-frogs disport themselves, and where they are occasionally joined by green lizards, which for hours together suspend themselves in odd positions, as if sporting with the laws of gravitation, and exhibiting the prehensile powers of their claws and tails. At each side of the case is a glass box with three drawers. Those in the corners are three inches square. These serve as retreats, to which the animals have easy access to bathe and hide themselves. The centre drawer on each side are for feeding and water, and the trouble of capturing flies is avoided by filling one of these drawers with gentles from a fishing-tackle shop. Caterpillars, butterflies, and spiders are consigned to the case, and remain there on the same terms as the rabbits one sees in the serpent-cases at the Zoological Gardens. There is this principle in the construction, that whatever might offend the eyesight of sensitive persons is hidden, for the interiors of the drawers are not visible, though the inmates can get at them easily, and thus the economy of the collection is complete, at the same time that it forms an ornamental and attractive object. The side compartments are lined in front with perforated zinc. The glass top lifts off, and is kept in its place with three brass pins, which are shown in the drawing. The central compartment allows of access to the interior, by lifting out any of the frames, and at the ridge there is a ventilator of perforated zinc running the whole length. The measurements of this case are, along the base, 32 inches; extreme height, 26 inches; width of the central compartment, 24 inches; depth from front to back, 22 inches. This is certainly a most ingenious and beautiful contrivance, and altogether worthy of a place in a drawing-room, or any apartment to which fern-cases and aquaria are usually admitted. Mr. Denny's other cases are on the same model; but instead of side boxes for water, they have square tanks of zinc in the centre, with banks of mosses and ferns all round. Tritons are much more at home in such structures than in aquaria; they can take the water when they like, or enjoy torpor undisturbed behind the tufts of adiantum and asplenium.

In these three cases Mr. Denny has a considerable variety of animated forms. He has a good collection of tree-frogs, for I was enabled this spring to add to his original pair a portion of the seventy odd specimens which I had for distribution, and which were scattered without meeting all the requests that were made for them. Green and brown land-lizards are conspicuous for their beauty and their interesting habits, and the recently-imported Japan salamanders are for their beauty alone worth preserving in the most handsome case that can be constructed for them. The crested triton exhibits its dorsal fringes, smooth newts show their spotted forms, and baby tortoises study the problem how to walk a mile?

Those of your readers who are interested in such pursuits, will at once perceive how the plan of these cases may be varied, and how wide a field is thus opened to us for natural history studies of a peculiarly interesting kind. My own collection of this season included all the British newts and snakes, of which latter class the common slow-worm has been for many years one of my favourites; all the British lizards, frogs, and toads; the green tree-frog, *Hylas arborea*, of which I had a consignment of seventy-five specimens from a kind friend who is engaged in natural history pursuits on the Continent: *Rana esculenta*, the edible frog, in all its stages of development up to the full growth, the most beautiful and characteristic certainly of the frog family; and though last, not least, the spotted salamander, *Salamandra maculosa*, from Japan, which is now imported in quantities, and may be had of Mr. Kennedy, of Covent Garden, at a few shillings each. They are as easy to keep as any of their congeners, and will eat earth-worms, caterpillars, wood-lice, and almost any other soft insect food. This creature is the most brilliantly coloured of any of the inmates of the vivary, the ground-work being jet black, blotched with soft orange; they are lethargic in their habits, and like the retirement afforded by a tuft of fern. One of the prettiest examples in the way of vivaries, at the Crystal Palace, is the large case of chameleons, which doubtless most of our readers have seen. Animals so peculiarly constituted should have a case to themselves, because of the warmth they require for their preservation during winter, and as snakes are seized with an occasional desire to swallow a frog whole, they should be grouped together, though I find them agree very well with large lizards, and all eat together out of the same pan of earth-worms. I shall have yet to obtain specimens of the horned frog, *Cerastrophis varius*, the Surinam pipa, *Pipa Surinamensis*, the curious salamandrops of the Alleghanies, and a few of those intermediate sirens and *protei*, of which such strange things have been told in fable and in fact. The facilities for obtaining them, and the means of preserving them, are the only limits I can recognize of their introduction to the home as living lessons of the workings of Almighty wisdom in regions of creation where beauty and adaptiveness have not hitherto been sufficiently sought. Knowing that many readers of RECREATIVE SCIENCE are equally catholic in their tastes and predilections, I here leave the subject of Reptile Vivaria, in the hope that these brief notes may be of use to those who are walking in the same paths of practical observation, as preferable to the teachings obtainable from painted pictures and specimens in museums.

SHIRLEY HIBBERD.

THE MEASUREMENT OF TIME BY ANCIENT AND MODERN CALENDARS.

THE only notion of time which we are capable of forming, is a succession of events; and the only events whose succession is regular, constant, uniform, and unquestionable, are astronomical phenomena; necessarily, therefore, they are our measures of time. Thus, we make our day the time which elapses between the departure of the sun (or of a given fixed star), and its return to the same apparent point of the heavens. One day we can divide into as many hours as we please; it is our own fault if we do not make their number suit our convenience. The hours we can, in like manner, subdivide into an exact and commodious number of minutes and seconds, without any fractions or odd bits to perplex and worry us. We could do the same with a year, with a lunar month, or with any other single recurrent astronomical interval. But when we have to compare one of these natural intervals with another, we cannot command their relative proportion;

that has been determined long ago, by the Great Arithmetician, without consulting us; and when we come to measure years by lunar months and by solar or sidereal days, we find they are not exactly commensurate; a multiple of the one, in whole numbers, does not precisely give the other, but leaves a surplus or a deficit, sometimes so large as to be discovered by the shepherds who watched their flocks by night, and sometimes so trifling as long to escape detection, and to make civilized nations hesitate before they will recognize its existence. The exact amount of surplus on which Leap-year and its corrections are founded, is one of these.

The successive calendars that have been given to the world have all been contrivances, more or less clumsy, for staving off the difficulty. Romulus has the credit of having originated the Roman calendar, and of having been the first to divide times and seasons by fixed limits, for the use of the people who submitted to his sway; but he made his year, which commenced in spring, to consist of ten months only, the first of which was March, followed by April May, June, Quintilis, Sextilis, September, October, November, December, which explains the names of the last four months as we still retain them, meaning the seventh, eighth, ninth, and tenth months of the ancient year.

Romulus gave 31 days to each of his four months, March, May, Quintilis, and October, and only 30 days to the six remaining, amounting in all to 304 days, which was the time he imagined the sun took to run through the different seasons of the year. He soon discovered that the period was much too short; consequently, to make matters straight, he ordained that the required number of supernumerary days should be stuck in amongst the others, without any name, by way of intercalation.

Numa Pompilius, who is said to have been intimate with Pythagoras, was the first reformer of the calendar; he imitated closely the order which the Greeks observed for the distribution of time. But instead of the 354 days of which they made their ordinary years consist, he adopted 355 for his—for no better reason than that it was an odd number. This piece of superstition he borrowed from the Egyptians, who had an aversion for even numbers, believing them unlucky. Note this, whenever February comes in question. Thus he curtailed by a day each of the six months, April, June, Sextilis, September, November, and December, to which Romulus had given 30 (in order that they might have only 29), leaving to the other months the 31 days which they originally had. Then, adding these 6 days to the 51 which were wanting in the year of Romulus to make up his own year of 355 days, he obtained 57 days, which he divided into two portions, to make out of them two other months, which he placed before the month of March, namely, January, with 29 days, and February with 28. He made no difficulty of giving an even number of days to this latter month, because he destined it to the offering of sacrifices to the infernal deities, to whose unamiable qualities an unlucky number seemed most appropriate.

He therefore made January, which he placed at the winter solstice, the first month of the year, instead of March, as heretofore, which Romulus had placed at the vernal equinox. And in order to give a perpetual duration to this arrangement, he borrowed from the Greeks the intercalation of 45 days in the course of four years, which days he distributed every two years into two portions, of 22 and 23 days respectively, introducing them after the sixth of the Calends of March, *i.e.*, previous to the first of March. This intrusive and interposing month was called by the Romans "Mercedonius," and "the Intercalary February." But, in spite of the invention of Mercedonius, there was an ever-increasing disaccord between the commencement of the civil year and that of the astronomical year. In despair of reaching the root of the evil, they determined to confer on the pontiffs the power of giving to the intercalary month an arbitrary number of days, which circumstances might appear to render necessary. From that moment, the calendar became an instrument of fraud and corruption. Cicero tells us that the pontiffs, by means of this discretional power, prolonged the term of office of their political friends, and shortened that of their enemies; that they hastened or retarded the date of moneys becoming due, according to their own good pleasure; that they increased the profits of the farmers of the taxes, or aggravated their losses. Ignorance, fraud, and superstition had brought things to such a pass, that festivals, called "Autumnalia," were celebrated in spring, while those belonging to the harvest were pushed into winter time.

Julius Cæsar resolved to remedy all these disorders, and to establish a regular, invariable intercalation, beyond the reach of arbitrary change, which should prevent such public evils for the future. An Egyptian astronomer, Sosigenes, lent his aid, and the result of their joint labours is what is commonly called the Julian reformation. It is based upon the astronomical fact that the year really consists of 365 days and ¼ (nearly); but the idea of regulating the civil year by a period which should contain a fractional number of days was at once rejected by an intellect so eminently judicious as Cæsar's. Suppose, in fact, that the civil year was made to consist of 365¼ days, and that a given year of this new calendar began on the 1st of January, at midnight; the next year it would begin at six in the morning; the year after, at noon; not till after the lapse of four years would the commencement of the year take place at midnight again. There is no occasion to insist further on the serious inconvenience that would result from so variable a commencement for a year. A second condition, which was requisite in order that any change in the number of days in a year should be easily made, was that the intercalation should be performed in a regular and simple manner. It must be allowed that this condition is fulfilled by the Julian calendar.

In order to repair the evil that had resulted from the defective length of the intercalary month Mercedonius, and the bad practices of the pontiffs, Cæsar assigned to the year of Rome 708 a length of 445 days. These 445 days consisted of the ordinary year, of a Mercedonius of 23 days, and of two anonymous intercalary months, one of 33 days and one of 34, which were placed between November and December. The year in which this reform occurred is called the Year of Confusion. It is the 46th before the Christian era.

The Julian reformation fixed the length of the astronomical year at 365 days and a quarter *exactly*. Mercedonius disappeared, and the days which then remained to be disposed of were distributed so as to give the least possible shock to the ideas and prejudices of the Romans. Thus, February retained its 28 days; to give it 30 would have compromised the safety of the state. Seven months, instead of five, reckoned henceforward 31 days. The new months raised to the dignity of *menses majores*, greater months, were Sextilis and December. Julius Cæsar and Sosigenes placed the complementary day in the month of February; but that step was not so bold as it appears to be at first sight. This unlucky month, this even-dayed month, was suffered to retain its ancient character; instead of promoting it to 29 days in the years of intercalation, they left it apparently in possession of its 28 original days. The trick is exactly the same as that which would be played by making two Wednesdays, one after the other, in the same week, and then calling it a week of seven days only. It is the reduplication of a day.

In February there was a sixth day before the calends of March, which was called "sexto-calendas," and on which the expulsion of Tarquin was celebrated. Between this day and its eve the intercalary day was inserted, under the name of "bissexto-calendas," or twice "sexto-calendas." Hence the name of Bissextile given to leap-years, or years of 366 days. Leap-year is probably derived from its leaping over *two* Dominical letters. The pontiffs who held office after Cæsar's death (which happened scarcely a year after this grand transformation) were entrusted with the execution of his reforms; but they made a great mistake in supposing that each bissextile that elapsed made part of the four years which fixed the bissextile following: so that, in reality, the bissextiles returned every three years. Consequently, these reverend personages, who had no hesitation in predicting the future from the flight of birds or the inspection of an animal killed by the sacrificing priest, did not comprehend that they must multiply $\frac{1}{4}$ by 4 to obtain 1. This error in the application of the Julian reform lasted 36 years. Augustus rectified the mistake by subtracting the bissextiles in excess whichhad been introduced during that period.

The Council of Nice, in 325, believed that the Julian calendar would always bring back the vernal equinox to the 21st of March, so exactly commensurate, they thought, were its intercalations with the true length of the solar year. The case turned out quite the contrary. The Julian reform supposes the length of the year to be 365 days 6 hours precisely; it is really about eleven minutes shorter. Had the error been allowed to accumulate, it would have thrown into the middle of winter a festival (Easter) whose celebration, according to ecclesiastical decision, ought constantly to follow the 21st of March by a variable number of days, but which, in extreme cases, could not go beyond the 25th of April. A reform of the Julian system of intercalation was the only means of attaining their object.

The Julian system, founded on an exaggerated length of the year, admitted too great a number of leap-years. To diminish that number in a regular manner, by making a nearer approach to the real length of the solar year, was the object, and has been the result, of the reform inaugurated by Pope Gregory the Thirteenth. The astronomers who worked at the calendar by his orders, having observed that the 29th of February every four years added upwards of forty minutes more than the sun actually employs in returning to the same point of the zodiac, they calculated that the accumulation of those odd minutes would amount to a day in 134 years, or thereabouts, and to three days in 402 years. To prevent, therefore, this inconvenient surplus from changing the place of the seasons in the calendar in the course of time—for Easter would have fallen at last in winter, and Christmas in summer—it was resolved that every 400 years (to keep to round numbers) three bissext days, or 29ths of February, should be omitted. It is quite clear that it is merely a matter of convenience and convention *when* it shall be decided to omit the additional days which would occur according to the usual rule.

In the Julian calendar, as adapted to Christian chronology, every year whose anno Domini is divisible by 4 is a leap-year; consequently, secular years (years which open a century), such as 1600, 1700, 1800, 1900, are all leap-years; because every number that is composed of figures followed by a couple of noughts or cyphers, is divisible by 4. They conceived the idea of suppressing those leap-years; but then they fell into the opposite error: the Gregorian calendar would not have contained a sufficient number of leap-years.

This mistake was avoided by making bissextile only the years composed of a *number of centuries* divisible by 4. In this system, three common years are followed by a bissextile year, and three common secular years (of 365 days) are followed by a secular bissextile year. Thus there is no difference between the Julian intercalation and Pope Gregory's intercalation, except for the secular years, 1600 (or 16 centuries) is bissextile on either system: 1700, 1800, and 1900, which are bissextile in the Julian calendar, are not so in the Gregorian. But the year 2000 (since 20 is divisible by 4), will consist of 366 days, both in the Julian and the Gregorian calendars; and so on.

The rule to know whether a secular year is bissextile or not, is very simple. Erase the two cyphers to the right of the figures which express the anno Domini: if those remaining figures are divisible by 4, the year is bissextile: if they are not, it is an ordinary year.

Let us now see how near the Gregorian calendar approaches to the actual truth. According to the Julian calendar, 10,000 years, or 100 centuries, are longer by upwards of 77 days than they ought to be. That calendar contained too many leap-years; it was requisite to suppress some of them. But, as we have seen, by suppressing a bissextile every secular year, too many days would have been subtracted; they therefore restored, every fourth secular year, the bissextile which had been removed in excess. Instead of suppressing 100 leap-years in 10,000 years, they tried whether they could not sufficiently approximate to the length of the astronomical year, by subtracting from the length supposed by the Julian intercalation not 100 leap-years, but 100 minus a quarter of 100, or 75. In 10,000 years, therefore, there is only a difference of two days, and not quite a half, between the amount of astronomical years and the years supposed by the Gregorian intercalation. In other words, at the end of 10,000 years, the mean temperature corresponding to the origin of that period, say the 21st of March, would be felt on the 18th, two or three days earlier. The labours of agriculture, supposing them rigorously confined to a fixed date, would only be displaced, after the lapse of 100 centuries, by the short interval of two or three times four-and-twenty hours. The Gregorian reform, therefore, satisfies every reasonable degree of exactitude.

Notwithstanding which, the Protestant princes of Europe closed their ears and their almanacks to Pope Gregory the Thirteenth's corrections of the calendar, and declined to receive them, because they were made by a power whom they refused to recognize. Of all the states separated from the Roman Catholic Church, Holland was the only one that accepted the reform at first, because it was still Roman Catholic in part. Gradually the others returned to reason and common-sense, without too closely regarding the quarter from whence it reached them.

In 1582, the year when the Gregorian reform was put in practice, the Pope's astronomers, of whom a learned Calabrian, Lilio, was the chief, were not content with providing for the wants of the future, but they tried to bring back things to the state they were in at the epoch of the Council of Nice. And as the equinox, fixed on the 21st of March by the prelates composing that council, had anticipated that date so far as to happen on the 11th of March, they decided to suppress ten days, and to call the day following the 4th of October the 15th, instead of the 5th, of October. This is the origin of the primitive difference of ten days which long existed between the dates of the countries where the Gregorian reform was adopted, and Protestant or Greek Church countries. The difference of ten days between the old and the new styles did not increase in 1600, which was bissextile according to both the rival calendars; but, according to the rules laid down, it was increased by a day in 1700, and by another day in 1800, making a total of twelve days—the actual difference between the dates of the Russians, who have adhered to the Julian calendar, and the dates of the rest of the nations of Europe. Russia still remains schismatic from the see of Rome, in chronology as in religious doctrine. The old style of reckoning time prevails throughout the Muscovite empire. The Russian Christmas-day falls on our Epiphany, or Twelfth-day. Although, therefore, some hundreds of miles separate Paris from St. Petersburg, it is quite possible for a courtly diplomatist to wish both their emperors a happy new-year in person, and to receive their respective personal acknowledgments.

In France, the reformation commenced on the 18th of December, 1582, the same year as at Rome. The French gave considerable prominence to leap-year. Events were recorded in public documents as occurring, for instance, in 1640, *Bissextile*. In Roman Catholic Germany, the new style was adopted in 1584, in consequence of the urgent solicitations of Rodophe the Second; in the Protestant States, in 1600, on February 19th = March 1st. Denmark, Sweden, and Switzerland followed the example of Germany. A few Helvetian villages only resisted the innovation; and, to obtain their acquiescence, the authorities were obliged to have recourse to fines and the force of arms. Poland accepted the reform in 1586, in spite of a sedition which the change excited at Riga. Finally, England made up her mind to drop the supernumerary days in 1752, on the 3rd = 14th of September. The difference between the two calendars amounted then to eleven days, in consequence of the year 1700, which had been bissextile, according to the Julian calendar, and common or ordinary, by the Gregorian alteration. The legalization of the new style in England was proposed to the Upper House by Lord Chesterfield, the celebrated letter-writer, who quotes the fact of his success to his son, as an instance that a man may talk about what he is only superficially acquainted with, and even persuade others that they are convinced by his arguments, provided he only speak gracefully, fluently, and with well-rounded periods.

But the lordly high-priest of the Graces did even more than that—he changed the beginning of the English year, which, until 1752, had commenced on the 25th of March. We forget, now, the discrepancy and confusion which reigned all over Europe as to the beginning of the year. In France, during the reign of Charlemagne, Christmas-day was the first day of the year; the 1st of March, about the year 755; Easter-day, under the Capet dynasty. Easter was almost generally the first day of the year during the twelfth and thirteenth centuries; whilst Germany, about 1500, adopted the 1st of January, which was followed in France, in 1563, by an edict of Charles the Ninth, and finally selected by England to commence the year 1752. The same legislative act in England, which substituted the Gregorian calendar for the Julian, also shortened the length of the year 1751 by nearly a quarter. The year 1751, like the years preceding, had commenced in England on the 25th of March; the A.D., therefore, ought to have changed on the 25th of March following; but it was changed earlier in order to be in accordance with continental nations. The English year 1751 was never completed; from the 1st of January, 1751, they called it 1752. The year 1751, therefore, lost the whole of its months of January and February, and the twenty-four first days of March. Lord Chesterfield, in consequence, was very near falling a victim to the anger of the mob; they followed him about, shouting, "Give us our three months back again!" They might, perhaps, have become resigned to the loss of the eleven days that were suppressed in the September of 1752; but few people would consent to become three months older in a single instant, although common-sense must have told them that the increase of age was purely imaginary.

This change in the commencement of the

year 1752 explains the double date which is found in many of our public writings during the months of January, February, and March. These documents bear the date, for instance, of February 15, $\frac{1751}{1752}$, meaning the 15th of February, old style, or according to the style of beginning the year on the 25th of March, and 1752, new style, or according to the style prescribed by Parliament, and adopted ever since, which fixes the beginning of the year on the 1st of January.

E. S. D.

GOODCHILD'S TROCHEIDOSCOPE.

Since communicating on the subject of clock-work chromatypes, I have been enabled to effect such alterations and improvements, as to supersede that instrument altogether, and to produce effects of great practical value in a totally dissimilar manner.

The numerous experiments I have tried have, at length, resulted in the production of a mechanical arrangement by which many new and beautiful effects are evolved, giving rise to many exceedingly interesting experiments, which are in their general bearing a faithful exposition of a natural law.

The instrument I shall proceed shortly to describe I have named the Trocheidoscope. The derivation of this I will not presume to thrust upon the attention of the reader; and as the mechanical parts require such nice and peculiar adjustment, I cannot expect that a description of them for the benefit of amateur mechanics will be of much service, and therefore would suggest a visit to Messrs. Horne and Thornthwaite, Newgate street, London, where the instruments, neatly made, are at the disposal of the public, in exchange for a suitable consideration.

My invention is based upon that law of vision by which the image of an object remains upon the retina after the object itself has been removed. This is easily illustrated by the following simple experiment: place a few coins or coloured counters in your hand, close it, then quickly open and shut it—the impression of the coins will be so perfectly impressed upon the eye, that you can count them and tell their positions after the hand has been removed. This phenomenon is exhibited by several instruments; a simple one is the Thaumatrope, which can be made as follows: Take a card, 4 inches long by $2\frac{1}{2}$ or 3 wide; upon one side sketch the profile of a dog, and upon the opposite side the figure of a monkey; then bore a small hole in the centre of the short sides, and insert therein a piece of string, or silk-twist, double. By holding them in the hands, and so twirling the card round,

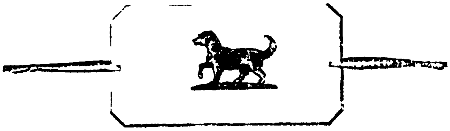


Fig. 1.

'Jacko' will appear upon 'Fido's' back, both sides of the card being apparently visible at the same time. Various other devices may be sketched, or parts of a sentence written, which, upon twirling, will appear readable.

Then there is the Phantomscope, by which figures, apparently in motion, pass the eye. They are drawn in various positions round a disc, slits are cut spokewise, through which the eye views the figures reflected in a looking-glass, which, when they are revolved so connects them together, that they appear dancing, etc., as the case may be.

The above instruments simply illustrate the phenomenon without being of practcal value.

Having now illustrated the principle of the Trocheidoscope, I will proceed to discuss it, appending a few experiments which will be very pleasing and instructive.

One original and distinctive feature of my machine is, that I do not allow the black pattern to revolve with the colours; and I gain a great advantage by this, as it enables me to exhibit natural objects, as birds, butterflies, etc., with all the beauty of their varied colourings, and also fixed patterns or devices

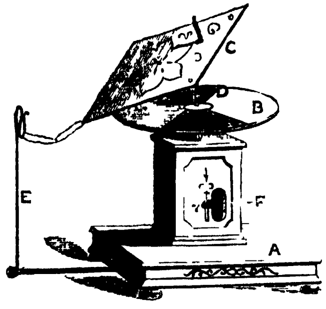


Fig. 2.—A, stand; B, coloured disc, C, black disc, D spindle, E, hook-arm, F, handle.

which are *coloured*, but not *multiplied*, so that they can be copied and tinted with the greatest ease, affording valuable suggestions to decorators, fabric pattern designers, etc., and becoming an important educational medium for instruction into the nature and laws of light and colour; while from its easy manipulation, and the variety of its effects, it forms, at all times, an interesting and entertaining recreative exhibition, the multiplicity of the objects suitable for exhibition affording ample scope for the ingenuity of those interested in cutting them out of blackened cartridge-paper, which operation is exceedingly simple.

The longest spindle (A, Fig. 3) is made with a joint, so that the upper portion can be deflected a few degrees, and is to be used for the pattern-tinting experiments. The patterns have the spindle hole out of the centre, so as to hang at an angle with the horizontal coloured discs, thus allowing plenty of light to play upon it; and to prevent the revolution of the pattern, I attach a string to the lower edge, which is hooked on to the tip of a brass arm, provided for the purpose; this holds the pattern sufficiently to prevent its rotation, but not so tightly as to interfere with the peculiar eccentric motion imparted to

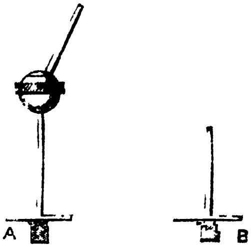


Fig. 3

it by the action of the instrument, giving it, as it were, an orbit of its own. On placing this in a good light (day or artificial), with the pattern facing the spectators, it will appear (on rotation) beautifully tinted, without being multiplied, and possesses an appearance of rotundity and solidity very curious and pleasing.

With a view to show the variety of subjects which admit of colouring, and as suggestions for designs in this class of experiment, I add a list of those I have tried, viz., peacock with spread tail, parrot, butterflies, moths, dragon-flies, etc., harlequin, fruit, 'Paris fashions,' wreaths of flowers, vase groups of ditto, porcelain, jewellery, as crowns, necklaces, patterns for crochet worsted-work, embroidery, tapestry, furniture, dresses, prints, mural decorations, geometrical devices, stars for illumination, illuminated letters, and a hundred others, which can all be beautifully coloured in an infinite variety of tints, which can be altered at the will of the operator by changing the coloured discs.

A curious effect is produced by a pattern formed of circular holes, of about 1-10th of an inch in diameter, and punched 3-8ths of an inch apart. These will, on rotation, appear as an interlinked chain with black centres, each ring showing all the colours on the disc below. Various graceful devices may thus be formed of a few holes punched in black paper. Again, if holes be pierced

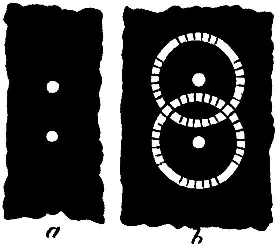


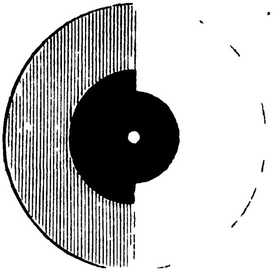
Fig. 4.—*a* shows as *b*

with an ordinary pin or stiletto, the effect will be that of fine lace, the colours showing faintly, in consequence of the minuteness of the perforations.

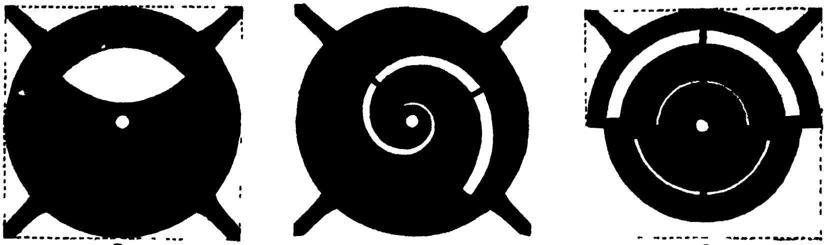
Buffon gives some curious experiments, performed with wafers, to show the natural contrasting colours produced to the eye from another totally different colour. They are performed as follows:—Place a red wafer or paper dot upon paper (black is best), look at it intently for a few moments, and then turn your eye to a sheet of blank white paper: a *green* 'spectrum' or image of the wafer will appear to view, the contrasting colour to red. Various-coloured wafers will produce other contrasts, as—

White	will produce	black.
Yellow ,,	,,	dark violet.
Green ,,	,,	red violet.
Blue ,,	,,	orange red.
Orange ,,	,,	blue.

Now all these effects can be produced on the Trocheidoscope in a much more palpable and permanent form, and very simply, thus: Provide some six discs, half colour, half white, and a black shader, as Fig. 5, using the short spindle (B, Fig. 3) for these and the "Protean Experiments," explained further on. Take a disc, say half red, half white, and place the black shader upon it in the position shown, screw these down together, and rotate; the outer black ring will be changed into a bluish green, and so f the other colours, which will be found to tally exactly with the effects given by Buffon.



Another series of experiments exhibits the effect of black, in various proportions, revolving at the same speed as the sectors of colour, and immediately upon them, and by a very simple contrivance the colours can be made to change while in motion, showing some very beautiful compound tints, and with the effect of magic. We will call these the "Protean Experiments," and their performance is very easy. Cut some pieces of cartridge paper into forms such as A, B, C, Fig. 6, with the spokes projecting, as shown; then screw on any disc, with the short spindle, and drop over this a coloured disc, and the black shader upon it; rotate. The colours showing through the perforations will not be lost, as if there were no black intervening, but will appear intensified and bright; then by just touching the spokes with the finger or light wand, the black shade will be retarded slightly, and the colours changed, and if only moved 1-20th part of an inch, a new set of shades appears, so that, although you may exhibit purple, you can have five or six shades of that colour, and so on. The seven-coloured disc, sold with the instrument, shows a fine variety of tints in these experiments, and the shaders A, B, and C show different effects, thus: A will show bands of colour; B colours merging one into the other, and when touched they appear to rise from the centre; C shows one tint at



C B A

Fig. 6.

a time, with softened edges, and is very pleasing.

I have twenty different devices for these experiments, all simple cuts in black paper, and exhibiting different effects. Various geometrical forms are suitable, as parabolas, angles, wavy or oblique lines, connected arcs of concentric circles, crescents, etc. etc.

A black heart, three-inch axis, revolving at the same speed, fixed tight on, near the top of the short spindle, gives some beautiful halo effects, which may be changed by touching. So does a double heart, both white and black, giving some aerial velvety tints. If a fragment of tinted paper be gummed on the black heart, near the spindle, a pretty floral effect is produced.

Again, a black paper cone, some three inches high, two inches base, fixed on the spindle by a paper tube glued inside, one side (which must be at right angles to the base), and revolved over a coloured disc, gives some very beautiful compound tints. The black disappearing and a coloured ball, like a closed tulip, occupying its place; by touching the cone with the finger, the

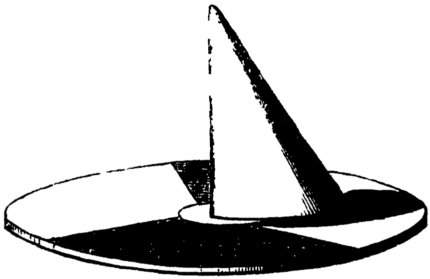


Fig. 7.

colours change, as mentioned in the foregoing experiments.

From the above outline, the capabilities of the instrument may be judged of, and which admit of further development, producing new effects of harmonious colouring at every experiment.

Guildford. THOMAS GOODCHILD.

FUNGI, THEIR MODE OF GROWTH, HISTORY, ETC.

WE have, at page 65 of the first volume, valuable information given for the collecting and preserving of Fungi, so as to form them into books, or attached to sheets of paper for examination, and they are well worthy the attention of the student of natural objects; for they are a very extensive class of plants, and perform an important part in the scale of creation, and though many of them are of the most simple structure, they are extremely curious in their form, and highly interesting, forming beautiful objects for microscopic investigation. They are very various in size, form, and mode of growth and habit; they are generally very rapidly developed, and for the most part grow upon dead or decaying organic matter, which they rapidly decompose, and thus greatly assist in the removal or conversion of that which is useless to itself, to a condition in which it is useful to others, so that they are constantly though silently, labouring for the advantage of others in the vast circle of created things. If a tree, or shrub, or flower is weak or sickly in any part, or when it has attained the full period of its growth, and begins to decay, and consequently its removal is desirable, it is certain to abound in one or more of these parasites, and when they appear in abundance, they are often called *blights*, *blast*, *mildew*, etc., and generally supposed to be the disease itself, instead of considering them indications of some diseased condition of the plant upon which they grow. All refuse matter and offal is greatly assisted in its decomposition by various species of Fungi, and in the matter which they, by their growth, assist to form, they themselves die, but leave vast multitudes of their seeds (sporules) ready to be developed when they, in their turn, come into the same condition as their parent. They are very various in size and substance, and though generally soft and juicy, some are very hard, others have a gelatinous nucleus, or are dry and powdery. Some are perennial, and of slow growth, others are extremely rapid in their development, such as the *bovista*, or *puff-ball*, which is usually found growing amongst grass, in fields and waste places; it has been computed to grow so rapidly as to form many millions of its cells per minute, and Fries asserts that he has counted, in a single individual plant of the smaller kind, called smuts, no less a number than 10,000,000 sporules. They are so minute and subtle, that they rise and are diffused in the atmosphere like smoke, and it must be borne in mind that each one of these minute buds, or sporules, is capable of reproducing a plant and progeny like its parent, when it finds a suitable spot and nutriment for its development, and were it not that we know that it is only under certain conditions that they grow, we might suppose that we should soon be overrun with such plants, having such astonishing powers of propagation; but it affords us an example

> "How Nature, through her ample reign displays
> The wisdom of her Maker! When I stray
> Beneath the gloom of her high-arching woods,
> Where Contemplation hears no other sound
> Than the low voice of the mysterious breeze—
> Or wander near her streams, befringed with moss,
> The least of which proclaims, and loudly, too,
> The forming finger of a God—or glance,
> With eye of rapture, o'er the lovely forms
> That everywhere obey the summer beam,
> And rise supreme in beauty, * * *
> I bow before the present Deity!"

Fungi possess various qualities. Many are extensively used as articles of food, as the mushroom and their allies; some are used as medicine, and many are very acrid and highly poisonous; others cause very serious destruction in dockyards, and ships, and buildings, by a minute species known by the name of *dry-rot*; some are very destructive to corn, in the form of *blight*, *mildew*, *bunt*, etc.; others attack the roots of plants, and are subterranean, like the truffle; great numbers grow upon the trunks and decaying branches of trees and shrubs, others upon the leaves, especially in a dead or dying state, and some while they are living.

It is not my intention to enter upon the different systematic arrangements of the Fungi which have been proposed by authors, but to follow that which is given in the English Flora, as being the best known to the English student, and illustrate and explain the terms which are used of some of the tribes and genera, as shown by the microscope, in the hope that others may be induced to examine for themselves many of the extraordinary and beautiful forms and structure of this wonderful tribe of plants. They are to be found at all seasons of the year, but most abundant in the autumnal and winter months, when flowering plants and shrubs are at rest.*

Coniomycetes (a term derived from two Greek words, signifying dust and fungus). Sporidia produced beneath the epidermis of plants, or within the matrix, naked.

This sub-order is composed of fungi in which the sporidia alone seem to be developed, there not being any common receptacle or thallus (such as will be described in other of the orders), or, if there is any, it is so small as to be very imperfectly distinguished.

In this division are arranged some of the simplest forms of the vegetable creation, viz., the *uredo* plants, which are developed beneath the cuticle or outer skin of various living plants. This they elevate in small various-shaped swellings, and at length burst either with an irregular fissure or a central pore. The cuticle by this process becomes discoloured, and forms a border or covering to the little uredo, beneath which it is seen as a collection of minute-coloured granules.

The *uredo*, from *uro*, to burn, is so named from the husk of corn, when attacked with it, becoming black like soot or charcoal, so that it appears as though burned. There are, however, many species of uredo which are not black, but reddish, brown, yellow, and white. They are found upon various orders of plants, as Compositæ, Labiatæ, etc.

It is probable that any one who has gathered blackberries, when they are ripe in our hedge-rows and waste places, will have noticed that the leaves are elegantly marked with purple, red, and orange-coloured spots, giving them a beautiful variegated appearance. If these leaves are examined on the under side, there will be found some small scattered or clustered, pale-brown, roundish, slightly-elevated spots, and others of an orange-coloured yellow. On further examination of these with a pocket lens of about an inch focus, some of the brown spots will be seen to have split open, and the sides as a very thin delicate membrane. These are formed by the cuticle of the leaf. In some other of these spots it will be seen that there has escaped, and lying in a dense little cluster, an orange-coloured powder. This is the little uredo, and, from its growing on the bramble-leaf, it is called the *U. ruborum*. If we remove a portion of this powder with the point of an instrument, such as the flattened end of a stout needle, a pen-knife, or lancet, and place it on a slip of glass moistened with a little water, and examine it with one of the highest powers of the microscope, it will be seen that each one of these minute little granules is of a globose or oblong form, or occasionally some will be seen of an irregular shape, as if its sides had been unequally pressed. These are called the *sporules*, and it will be seen that each one is formed of two membranous tunics, with an intervening space; the outer tunic is covered with very minute projecting points, and the inner one filled with minute unequal-sized bodies, giving it a clouded appearance, and of a bright ochraceous-yellow colour. It is thought that these minute bodies are the ultimate sporules or seeds of the plant.

Fig. 1 represents a leaflet of the common bramble, with the uredo of the natural size on the under side of the leaflet; *a*, the uredo slightly magnified, showing the swelling of the cuticle of the leaflet; *b*, when it is split for the escape of the uredo seen beneath it; *c*, different forms of the uredo, as seen highly magnified, showing the outer tunic with its projecting spicule, and the inner filled with ultimate sporules.

There are other minute fungi found upon

* The Rev. M. J. Berkeley's "Outlines of British Fungology" gives the characters of above a thousand species, and the best distinctions for classification hitherto attained.—Ed. R. S.

the leaves of the bramble, but these we will describe afterwards, as they belong to other genera.

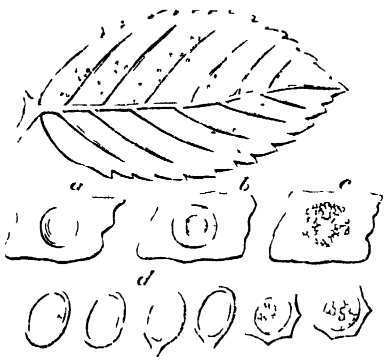
The rose leaves of our garden are very frequently mottled over with yellow or

FIG. 2

brownish spots; if these are examined on the under side, there will be found a greater or less number of small orange-yellow spots, powdery looking, in the centre of an elevated, pale, membranous border. These are little clusters of the *Uredo rosæ*. If these are examined as the above species, they will be found to be formed by the cuticle of the leaf in the same way; but the sporules are larger, oval, or unequally formed, and some of them furnished with a short pellucid pedicel or foot-stalk.

Fig. 2 represents the leaflet of the common rose, with clusters of the uredo of the natural size; *a*, one of them slightly magnified, showing the elevated cuticle of the leaflet; *b*, when open for the escape of the uredo; *c*, where they have entirely escaped; *d*, different forms of the uredo, some filled with ultimate sporules, and of an orange-yellow colour; others empty and colourless, and some with a short pedicel.

The birch and several species of poplar leaves are often elegantly variegated, on the under side, with the *Uredo cylindrica*. The little clusters are scattered or crowded together; at first they appear as minute, conical-shaped swellings, of a pale yellowish colour. These shortly burst the covering



formed by the cuticle of the leaf at the apex, and then become flat and spreading, of a bright orange-yellow colour. If these are examined as those above, the sporules will be seen of a different shape. Some are colourless, sub-globose, and contracted at the base into a pear-shaped form. These are barren, or have discharged their ultimate sporules. Others are nearly cylindrical, obtuse at both ends, and of an orange-yellow colour, filled with ultimate sporules.

Fig. 3 is the leaf of the birch, with the uredo of the natural size; *a*, one of them slightly magnified; *b*, showing the opening at the apex, and a section of one with the sporules escaping; *c*, different forms of the sporules; some yellow, and filled with ultimate sporules; others barren, and contracted at one end into a pear-shaped form.

Another species, the *Uredo saliceti*, is found very frequently on the under side of the leaves of various species of willows, where it forms very minute but prominent small spots, which at length become slightly ruptured for the escape of the uredo, of a pale yellowish colour. If these are examined as the others with a high magnifying power, they will be found of different shapes; some small, glo-

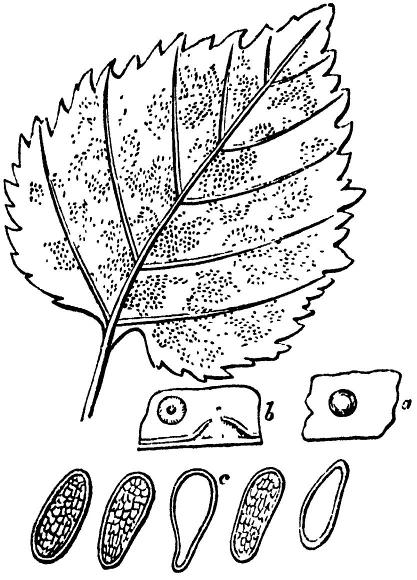


FIG. 3.

bose, yellow coloured, and filled with ultimate sporules; the outer tunic rough, with elevated points; others are globose, smooth, and some are pear-shaped, wholly or partly filled with the granular ultimate sporules, or quite empty and colourless.

Fig. 4 is a leaf of the willow, with the uredo scattered upon its under surface; *a*, sporules of various shapes, as seen when highly magnified.

These specimens of uredo, which are easily found, will be sufficient to make the student acquainted with this very curious genus of fungi, and many, no doubt, who are not familiar with this class of plants, will be surprised to find them associated with that which is better known, the mushroom; but, upon investigation, he will find a great diversity of form and structure amongst them, and some of these we propose to illustrate; but have chosen to begin with the lowest and most simple form, in order that we may trace upwards, and show, at least in part, some of the marvellous works

FIG. 4.

of Him who formed them and created them, for—

"These are Thy glorious works, Parent of good.
Almighty! Thine this universal frame,
Thus wondrous fair. Thyself how wondrous, then!
Unspeakable! who sits above these heavens,
To us invisible, or dimly seen
In these Thy lowest works; yet these declare
Thy goodness beyond thought and power divine."

Though these little fungi are of such a simple structure, and so minute as to require a magnifying power, which increases them to near a thousand diameters, to show them as in our illustrations, they are of great interest and importance, especially to the agriculturist, from the circumstance that growing corn is liable to become attacked with two of the species, the *Uredo segetum* and *U. caries*. These are known in different parts of the country by the common names of smut, brand-dews, dust-brand, scorch-blast, canker-brand, burnt-corn, etc.

Specimens of these, mounted upon slides of glass ready for examination by the microscope, may be obtained of the dealers in microscopic objects.

The *U. segetum*, or dust-brand, attacks all the cereal grasses, such as wheat, oats, barley, and rye; but *U. caries*, the bunt or stinking brand, has hitherto been only found on wheat. They are very destructive to the growing crops of these cereals, not only in lessening the quantity of corn produced, but in greatly diminishing their nutritive quality, and the *U. caries* communicates to it an offensive taste and smell. From experiments which have been made, it appears that the ultimate sporules of the parasite are absorbed together with water and the nutritive parts of the soil by the roots, and are thus conveyed into the cellular structure of the plant, and there become developed. It thus becomes a matter of great importance to the agriculturist, to prevent these being mixed with his seed, or to use such means as will destroy the sporules of the fungus, and not injure the grains for seed. A field of corn attacked with the uredo will scatter myriads of its sporules upon the ground, and there remain ready to be absorbed by the roots of corn, if it is again sown in the same ground; consequently it is important to change the crop for that of some other, as clover, grass, etc. Again, from the minuteness of the sporules, many will attach themselves to the grains of corn intended to be sown, so that it becomes of importance to remove them as much as possible. This is effected by well washing in water, or, from experiments which have been made, mixing the seed-corn with lime destroys the sporules; and if the land to be sown is also dressed with lime, it is found to be very efficacious. Careful experiments have been made by M. Fee upon rose-trees affected by the uredo common to those plants, and he has shown that they are also absorbed from the soil by the roots, and are thus conveyed into the tree. And when it is remembered the numbers and minuteness of the sporules and their lightness, so that they are easily conveyed by the winds in every direction, and that these falling to the ground are washed into the soil by the rain, ready to be absorbed by the root; it is not surprising that they are so common, but the wonder is that they are not even more abundant than they are.

RICHARD DEAKIN, M.D.

LUNAR HALOS,

SEEN AT THE BEESTON OBSERVATORY.

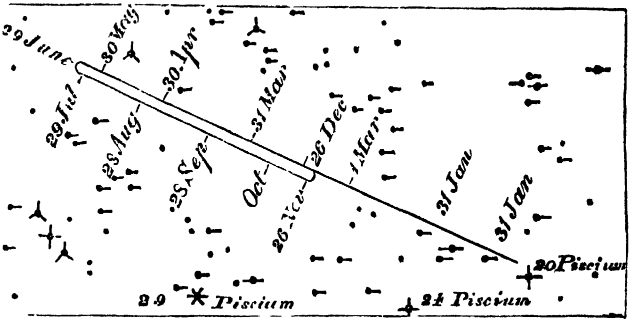
ON October 3rd, after a gale from W.N.W., which commenced at 7h. 45m. A.M., and lasted violently till noon, and then less violently all the afternoon and evening, there was the unusual occurrence of four lunar rainbows. The evening was showery, and at 7h. 30m., after a smart shower, a very perfect lunar

rainbow was formed, which is shown in the accompanying photograph. At 7h. 45m. P.M. there was a very perfect belt of light, passing vertically through the moon more perfect than I had before seen, which remained visible for five minutes. Other rainbows occurred at 8h. 40m. P.M., 9 P.M., and 9h. 50m. P.M.

E. J.

THE PATH OF THE PLANET NEPTUNE.

HEREWITH is a map of the path of Neptune till the end of this year, which will enable amateur astronomers to find him out. It is from the "Populair Sterrekundig Jaarboek," for 1860, published by Professor Kaiser, of Leyden. Neptune was nearest to the earth on Sept. 17th, his distance being then 2,751,728,000 miles. On Sept. 17th, Neptune was on the meridian about midnight; on Oct. 17th, at ten o'clock; on November 1st, at nine o'clock; on Nov. 17th, at eight o'clock; on Dec. 2nd, at seven o'clock; on Dec. 16th, at six o'clock; and on December 31st, at ten minutes past five.



From the map it will be seen that the guide-stars are very small, for the most part: it will, therefore, be next to useless to hunt for the planet while the moon is above the horizon. One of the guide-stars on the chart is given as of the sixth magnitude; it is, however, rather of the fifth, or, at the lowest, 5·5. The star I allude to is 20 Piscium.

The greatest apparent diameter of Neptune is but 2·7″, so that a practised eye and a good instrument are necessary to coax him to show a disc. In common telescopes he looks only like a star of the seventh, or at most of the sixth, magnitude.

IGNATIUS BULGARDO, LL.D.

Monte Video.

MAORI CUSTOMS AND TRADITIONS OF THE DELUGE.

ETHNOLOGISTS tell us that the language of the aboriginals of New Zealand, the Maoris —which word, by the way, means simply natives—shows their descent from a people who spoke Sanscrit; and, further, that the course by which they reached their present country from Sumatra is clearly traceable—that they are, in fact, Malays, and so connected with India.

Now, it is equally well known that from the Sanscrit have been derived several of the languages of Europe. "The Sanscrit language," says Sir William Jones, "whatever be its antiquity, is of a wonderful structure; more perfect than the Greek, more copious than the Latin, and more exquisitely refined than either, yet bearing to each of them a stronger affinity, both in the roots of verbs and in the forms of grammar, than could possibly have been produced by accident; so strong, indeed, that no philologer could examine them all three without believing them to have sprung from some common source, which, perhaps, no longer exists. There is a similar reason, though not quite so forcible, for supposing that both the Gothic and the Celtic, though blended with a very different idiom, had the same origin with the Sanscrit."

No one, perhaps, now doubts that the Gothic—the parent of Anglo-Saxon, or English—is of the same family as this most venerable tongue, from which has descended that of the Maoris, and therefore, upon the sure evidence of allied languages, we are proved to be distant cousins of our fellow-subjects of those antipodal regions.

It cannot be otherwise than interesting to those who pursue ethnological studies, therefore, to recognize any usage among the New Zealanders which may seem to be connected with one of our own. We speak only of a probable connection, because, after all, the customs we are about to adduce as alike, may have no other relation to one another than an accidental similarity. There may be a very close resemblance of features where there is no actual kindred. It is to be particularly noted, however, that the matter to which we refer—however trivial it may be thought at first sight—appears, among both people, to be connected with religion, which circumstance gives it an importance that it would not otherwise possess.

Mr. Thomson, in his "Story of New Zealand," lately published, speaking of the amusements of the Maoris, says: "Maui is a game played exactly like what in England children call cat's-cradle. Two parties play at it, and in the shapes assumed by the strings, the players detect houses, canoes, and men. Maui is mentioned in ancient songs, and was invented by the deified man whose name it bears."

Here, then, is a game in use among a heathen people, on the opposite side of the globe, exactly like one to which every English child, almost, is introduced as soon as it is able to learn it. Among the New Zealanders it has evidently had reference to some religious notion or other. They may have forgotten its real import, but this can surprise no one, if he will but consider that we amuse our children with the same game, and not one in ten thousand of us either knows its true name, or suspects the religious lesson which—child's-play as it is—there can be no doubt that our forefathers meant to inculcate by it, and which that name implies.

Mr. Thomson calls it cat's-cradle. We are old enough, we believe, to remember the introduction of that corruption. Fifty years ago, we suspect, it was commonly called scratch-cradle, and, as usual, the traditional sound, though supposed to have no meaning at all, was nearer to the proper one than our modern correction of it. The process by which words are thus altered is obvious. The time comes when they are little used; their meaning is gradually lost sight of, and then some common word of like sound is substituted for them. It has been so, we doubt not, in the case before us—scratch, a word in everybody's mouth, took the place of *cratch*, which had become obsolete.

In our old English Bibles, before the last translation in the time of James I., the twelfth verse of the second chapter of St. Luke's Gospel was rendered thus: "And this shall be a sign unto you: ye shall find the child swaddled, and laid in a cratch." We retain the word cratch, in the form of crate, for a large, strong basket. The cratch was, in those days, as a similar basket is now, the moveable manger of an inn. It was filled with fodder, and placed before the horses at the inn door, or in the stable, as the case might be. Every one who knows the nursery game, will see in a moment how well a crate is represented by the strings—some in parallel lines, and some running across them—as they are stretched between the hands and divided with the fingers. Such was the cratch-cradle—the manger—in which the Saviour was laid in the stable at Bethlehem, and our game was, of old, nothing less, we may believe, than a first lesson in Christian doctrine, conveyed in a manner which was likely to find its way to a child's heart.

It is quite consistent with known facts to suppose that such a game as this—if, as is probable, it had a religious significance among our pagan ancestors, and was therefore dear to them—might be retained for the use of their descendants when converted to Christianity, a new meaning having been assigned to it by the teachers of religion, with the design of making that edifying which could not be all at once rooted out: it was easier to persuade half-converted people to look upon their cherished observances and memorials as part of the new creed, than to induce them to give them up altogether.

If our conjecture is correct, that it has come down from Sanscrit, or older times, having, with us, been Christianized in its descent, it is a curious circumstance enough; but not less curious would it be that two peoples, so far removed from one another as we are from the New Zealanders, should have among them an exactly similar game—assuredly, in both countries of religious import—while there was no ancient connection between them to account for it, so singular an identity of usage, if merely casual, would be strange indeed.

That it reached the New Zealanders from a remote age, seems certain from their account of it. Mention is made of it in their ancient songs; the introducer of it had something divine about his character, and it was named after him. This is a remarkable history of a matter so apparently insignificant. It is only reasonable to suppose that there must have been originally some foundation for it, the recollection of which has now passed away, and it is far from impossible that the lesson it taught at first was one of true religion. In maui the Maoris see houses, canoes, and men. The very same collocation of the strings in which we discern the cratch, gives no inapt representation of the ark, at once a house and a canoe, occupied by men; and so the deified man to whom their tradition points may be no other than Noah himself. HENRY ELEY.

Broomfield Vicarage.

THE STRUCTURE AND MOVEMENTS OF COMETS.

COMETARY STATISTICS.

ALTHOUGH we have hitherto refrained as much as possible from embarrassing the reader with any tedious display of figures, yet the period has now arrived when we must say something about the real dimensions of comets, of the orbits they describe, also of their number and duration of visibility.

The following are the real diameters, in English miles, of the nuclei of some of the comets which have been satisfactorily measured within the last century:—

Examples of a Large Nucleus.

	Miles.
The comet of 1845 (iii.)	8,000
The comet of 1815	5,300
The comet of 1825 (iv.)	5,100
The comet of 1843 (i.)	5,000

Examples of a Small Nucleus.

The comet of 1798 (i.)	28
The comet of 1806	30
The comet of 1798 (ii.)	125
The comet of 1811 (i.)	428

The dimensions of the *coma*, or heads, of comets also vary much, thus:—

Examples of a Large Coma.

	Miles.
The comet of 1811 (i.) . . .	1,125,000
The comet of 1835 (iii. Halley)	357,000
The comet of 1828 (Encke) .	312,000
The comet of 1780 (i.) . . .	269,000

Examples of a Small Coma.

The comet of 1847 (v.) . . .	18,000
The comet of 1847 (i.) . . .	25,500
The comet of 1849	51,000

It should be remarked that the real dimensions of comets are found to vary greatly at different periods of the same apparition, for there is no doubt that many of these bodies *contract* as they approach the sun, and expand again as they recede from it—a fact first noticed by Kepler.

The following measurement of Encke's comet in 1838 will illustrate this:—

1838.		Diameter. Miles.	Distance from Sun.
Oct.	9	281,000	1·42
„	25	120,500	1·19
Nov.	6	79,000	1·00
„	13	74,009	0·88
„	16	63,000	0·83
„	20	55,500	0·76
„	23	38,500	0·71
„	24	30,000	0·69
Dec.	12	6,600	0·39
„	14	5,400	0·36
„	16	4,250	0·35
„	17	3,000	0·34

The tails of comets, more especially of those visible to the naked eye, are often of stupendous length, as the following table will show:—

	Greatest Length. °	Miles.
The comet of 1744 ...	24 =	19,000,000
The comet of 1769 ...	97 =	40,000,000
The great comet of 1618,	104 =	50,000,000
The comet of 1858 (v.)	60 =	42,000,000
The comet of 1680 ...	60 =	100,000,000
The comet of 1811 (i.)...	25 =	100,000,000
The comet of 1811 (ii.)		130,000,000
The comet of 1843 (i.)	65 =	200,000,000

Cometary orbits are usually of immense extent. Thus:—

(i.) *As to Perihelion Distance.*

Greatest known.	Miles.
The comet of 1729 . .	383,800,000
Least known.	Miles.
The comet of 1843 (i.) . . .	538,000

(ii.) *As to Aphelion Distance.*

Greatest known.	Miles.
The comet of 1844 (ii.)	406,030,000,000
Least known.	Miles.
The comet of Encke . .	388,550,000

We have already seen that the period of the shortest comet yet known is but little more than three years—a striking contrast to the periods exhibited in the following table:—

The comet of 1744	122,683
The comet of 1844 (ii.) . . .	102,050
The comet of 1780 (i.) . . .	75,314
The comet of 1680	15,864
The comet of 1847 (iii.) . . .	13,918
The comet of 1840 (ii.) . . .	13,864

From the earliest period up to the present time, the number of comets, of which there is any trustworthy record, is nearly 800; but it is only within the last hundred years that optical assistance has been made available, the real number of comets that have appeared is probably not less than 5000, especially when we consider that many, doubtless, have been visible only in the southern hemisphere.

Period.	Comets observed.	Orbits calculated.	Comets identified.
Bef. Christ. Era	69	4	1
Century i.	20	0	1
ii.	23	2	1
iii.	40	3	2
iv.	24	0	1

Period.	Comets observed.	Orbits calculated.	Comets identified.
Century v.	18	1	1
vi.	27	4	1
vii.	31	0	2
viii.	15	2	1
ix.	42	1	1
x.	26	2	1
xi.	36	3	1
xii.	26	0	1
xiii.	26	3	1
xiv.	29	3	1
xvi.	31	13	2
xvii.	25	20	3
xviii.	65	64	4
xix. (till Nov. 1860)	141	134	30
Total	714	215	57

Comets remain visible for periods varying from a few days to more than a year, but the most usual time is two or three months. Much depends on the apparent position of the comet with respect to the earth, and especially on its own intrinsic lustre. There are some few comets which have only been seen on one occasion, unfavourable weather preventing further observation. Such was the case with a comet seen in August, 1856, by Mr. E. J. Lowe, of Highfield House. Amongst the comets which have remained longest in sight, we may mention the following:—

	Months.
The comet of 1811 (i.)	17
The comet of 1825 (iv.)	12
Halley's comet, 1835	9½
The comet of 1847 (iv.)	9½
The comet of 1858 (vi.)	9
The comet of 1844 (ii.)	8
The comet of 1847 (ii.)	8

This concludes our series of papers on "The Structure and Movements of Comets."

G. F. Chambers.

Eastbourne, October 22, 1860.

THE LOW TEMPERATURE OF MOUNTAINS.

Mr. J. A. Davies attributes the low temperature of mountains to the greater attenuation of the atmosphere in great altitudes, and its consequent diminished power of conducting heat.

There must be one of two causes to produce the heat, or temperature, of the earth; either it must be generated, or come from within, or be received from without—from the sun, for instance—in either of which cases the atmosphere would, in my opinion, have the reverse effect of that given it by J. A. Davies.

The opinion seems to gain ground daily, that the great connecting link between the heavenly bodies composing the solar system, is electricity. One of the terrestrial phases of electricity is heat. Whether electricity is in some degree self-generative in the orbs of the solar system, is uncertain, but probable, and also probable that what we understand by temperature is a modification of electrical phenomena in connection with our sense of feeling. Every substance has its mean temperature, and this temperature is the mean of the earth's. This mean temperature of the earth is kept up by absorption and radiation. If the earth, for instance, receives or absorbs heat (or electricity) from the sun, like the sun it also radiates off its superfluous heat, and if this heat, or part of it, is self-generative, the superabundance is also radiated off. Now, the mean heat of bodies is not to be found at the surface, for there radiation goes on; but at some distance therefrom, according to the bulk and conditions of the body.

On the principle of radiation the low temperature of mountains may, I think, be explained. They are further from the location of the centre of mean temperature, and they also expose more surface to be radiated from, within a given space, on the circumference of the earth. I treat the atmosphere as an integral part of the globe, and subject to the same laws that govern the whole. It may, like any other portion of the exterior, or circumferential parts, fluctuate in temperature in parts; but on the principle, or law, of radiation, it is cooler on the outer circumference, and not by reason of its attenuation.

I am inclined to look for an explanation of the increasing temperature found by penetrating below the surface of the earth's crust, in radiation keeping the mean of temperature below the surface, and to think that volcanic eruptions and thermal springs proceed from local causes, because there are physical objections to the theory of excessive internal heat.

I have referred to electricity as an agent. I may be excused for remarking that it is highly probable that the great Newtonian principles of centripetal and centrifugal forces, with gravitation, may all be explained by electrical cause and effect. I wish some of the correspondents of the RECREATIVE SCIENCE would give their views on this interesting inquiry, as well as on the causes and operations of temperature. Some highly interesting subjects of science and philosophy have already appeared. H. I. M.

THE MANUFACTURE OF COINING-DIES.

IN connection with the process of coining, perhaps there is not a more interesting subject than that of the manufacture of dies, and as at page 41 we gave some account of the bronze money which will soon be current in Great Britain, it may not be inappropriate to furnish now a description of the mode of converting square bars of steel into dies for impressing coins generally.

Abundant evidence testifies to the fact that in the early periods of British history, both prior to the arrival, and after the departure, of the Romans, the money in use among the inhabitants of this island was cast in moulds. The coining implements of the Royal Mints of those primitive times were, therefore, few in number, and of simple character. A pair of clay moulds, rudely impressed with the devices intended to decorate the coins, a crucible for fusing the metal in, a ladle for pouring it when fused, and a file, or cutting instrument, for finishing the money, constituted the entire plant, for example, of some of the Heptarchic mints. Several of the petty kings of the Heptarchy, in short, practised money-making in the identical way in which the art of counterfeit coining, or smashing, is practised in our own time. The Romans, on their evacuation of Britain after their 400 years' tenancy, left many specimens of struck coins for the benefit of their Saxon successors; but neither the latter nor the Britons understood the art of die-engraving until many years subsequently. They, on the contrary, as has been said, resorted to the melting-pot and the mould for the fabrication of money. The march of improvement—in those days a very slow march indeed—at length, however, reached the art of coining, and the blacksmith and engraver stepped forward to assist the moneyers, as those who worked in mints were called, in the prosecution of that art. The step was a great and successful one in advance. With a slight extension of the working staff of a royal or archiepiscopal mint—for the Church in those remote ages did not disdain to make its own money—a larger quantity of coin was produced in a given time, and that of a more artistic kind. The coins gained also in durability from this change in the process of manipulation. The metal from which they were now made was first hammered and cut into form, or else cast in the form of globules, and then imprinted by means of forcible blows administered to dies placed upon them with the desired "image and superscription." The effect of these sledge-hammerings was to compress and make hard the coin at the same time that it was stamped, and thus to render it more fit for the wear and tear of circulation.

It is true that the earliest specimens extant of struck pieces of British money afford strong proofs of the absence of skill among the artists employed in the engraving of the dies which gave them form; but they mark an important era in the annals of the coinage, and ought not to pass unnoticed. Dies have been used ever since the Norman conquest, and are likely to be used in all future time in the manufacture of English money.

Of the gradual growth towards excellency which marks the history of die-sinking, it is not necessary here to speak. The museum of the existing Royal Mint contains a collection of dies which are well worthy the attention of those students of numismatic science who desire to add to their knowledge of the subject, and, thanks to the courtesy of the present master of the great money manufactory, Dr. Graham, F.R.S., that museum is accessible. On its shelves are to be found dies of the rudest form, and which bear evidence of the "hammer-and-tongs" system of ancient days, as well as the most perfect productions of Pistrucci and Wyon.

It is usual to speak of the striking of coins still, but from the date of the introduction by Blondeau—about A.D. 1660—of the screw and lever press into the Mint, in the Tower of London, the term is, to some extent, a misnomer.

Pressure upon, rather than blows given to dies, has been the means of getting up impressions on discs of metal since that period, and, curiously enough, that pressure in the existing Mint is given by the ingenious application to the presses of atmospheric power. Interesting as it might be to the readers of RECREATIVE SCIENCE to have this mode of coining explained, that explanation cannot now be given. It may be permissible to say, however, that every piece of money, whether of gold, silver, or copper, which has been brought into circulation from that place since 1810, owes its impression entirely to the weight of the atmospheric column. For half a century past, the air we breathe has coined the money we use, and this simple fact speaks volumes for the advancement of scientific skill.

It is time, though, that the question of die-making, as at present carried on, should be spoken of. Without dies, no legitimate coining can be practised, whatever the ladle and mould may, in an illegitimate sense, accomplish "down Whitechapel way." All the dies used in the Royal Mint are made within the walls of that establishment. All bars of steel intended for conversion into coining-dies are required to be of the finest quality obtainable in the kingdom. There are two reasons for this: the first being that it shall be capable of bringing out the fine lines of the engraver with distinctness; and the second, that it shall be strong enough to withstand, for a lengthened period, the wear and tear of stamping. Steel, prepared by the Messrs. Turton, of Sheffield, it may be said, *en passant*, has answered more satisfactorily these conditions than that of any other firm. The selection of the steel to be used is an important consideration, too, in respect to the quality of the money to be coined. If the dies be bad, the money coined from them will be bad too. Practice has made the Mint authorities and workmen excellent judges of the peculiar chemical and mechanical characteristics of die-steel, and they are seldom mistaken in choosing it. Briefly, it may be stated that it should be of moderately fine grain, uniform texture, and free from spots when polished.

Allowing that a new coinage—as, for example, that of bronze now on the eve of publication—has been determined on, and a number of bars of square steel of a satisfactory kind have been obtained for the fabrication of dies to impress it, the first stage in the manufacture of those dies is as follows:—A piece of steel would be cut from the highly-heated end of a bar, and roughly forged to a round form. The operation of forging from the square improves its texture, and gives it, to speak technically, "fibre." It is next annealed and taken to the lathe, where it is smoothed by cutting-tools externally, and one end especially is made perfectly plain and bright. In this state it is ready for the hands of the engraver. Supposing that his design has been approved by the Government and the royal personage who is interested in its adequate execution, the engraver would proceed to sketch, upon the faced end of the prepared steel, a copy of that design. Satisfied of his faithful transference from the paper to the steel of the portrait, say of the Queen, he would commence engraving it by the aid of small cutting-tools of hardened steel, and, by gradual steps and slow, would at length have the satisfaction of seeing the image appear in intaglio upon its surface. As may be imagined, an enormous amount of patient labour must be bestowed upon this small field for exertion, and it is only after taking repeated impressions in clay or type-metal, or some other plastic substance, and touching and retouching his work hundreds of times, that the engraver is convinced of its general correctness and good effect. Perseverance and talent combined, it is well known, achieve wonders, and these are both requisite in an extraordinary degree in the engraving of dies. They triumph in the end in the production of what, in this instance, is named a *matrix;* and the next task is to harden it. This is attended with some difficulty, and is of exceeding importance, for, if failure results, the patient labour of many months would be wasted. Nothing is more simple than the ordinary mode of hardening steel. Fire and water are the media, as every jobbing-smith would tell us, for accomplishing it. Hardening a steel matrix is quite another thing, nevertheless. The preservation of the delicate and beautiful lines of the intaglio engraving must be jealously regarded. In order to compass this preservation, the face of the die must be covered by a mask, that mask being a black one. It is usually composed of some fixed oil, thickened to the consistency of salve with animal charcoal finely powdered.

This compound, or sometimes one of lamp-black and linseed-oil, is spread over the work on the die, and the whole may be, and sometimes is, defended yet further by an iron ring. This ring may also prevent a fracture of the steel. The die is next inverted in a crucible, and completely embedded in animal charcoal. The whole is then heated to about the redness of a bright ripe Kentish cherry, and the die, removed whilst in this state by the aid of a pair of tongs, is plunged into a quantity of cold water of sufficient magnitude to prevent its becoming sensibly heated by the reception of its red-hot tenant. Held still by the tongs, the matrix is agitated until it ceases to hiss at the rough treatment to which it is submitted. If there is any disposition on its part to pipe and sing during its bath, it is most likely that the engraver will have no reason, on the withdrawal of his work, to do either; for the chances are that he will then find the music to have proceeded from a mouth, or fissure, in the steel, and that his work is ruined. Many other processes have been employed in hardening dies, but none have superseded the simple and effective one described.

Allowing that the operation has proved successful with the imaginary die for the bronze coin, and that, so far, it is safe from harm, it would next require "tempering." This consists in making it less brittle, and slightly less hard, and it is accomplished by putting the matrix into water, gradually raised to the boiling point. After this kind of cooking, an iron ring may be "shrunk" upon it; that is, the ring may be put on when in a red-hot state, and in cooling it will contract tightly around the die, and keep its parts together more firmly when under pressure. If the mask has effectually done its duty in protecting the engraved face from harm or oxidation by burning, the die is next polished, and is then a complete matrix. In this condition it might be made to give impressions to coins, and in past times would have done so. The practice at modern mints is different. The matrix is used for getting up one impression only, and that on steel. It would be running too great risk and involve too much labour, to use dies for coining which had been thus prepared. Well, then, another piece of steel is cut from the square bar, and forged or wedged into a round form. It is also annealed, and put into a lathe and turned. Instead, however, of the end being made flat, as in the case of the matrix, it is purposely left of an obtusely conical form, as in Fig. 1; and this is destined to become what is called a *puncheon*, or steel copy of the matrix in relief. It is made perfectly true, and flat at its base. In this condition it is placed in a powerful press, having long fly-arms heavily weighted, and attached to a vertical screw passing through it. The matrix is fastened beneath the lower end of this screw, and must rise and fall with it, when a number of men raise, by means of the fly-arms, the screw, and then cause it to descend forcibly. The conical apex of the embryo puncheon thus receives the whole weight of the screw and fly-arms, with the increased force of their descending momentum, and the matrix imprints a portion of its device upon that apex, which thus becomes

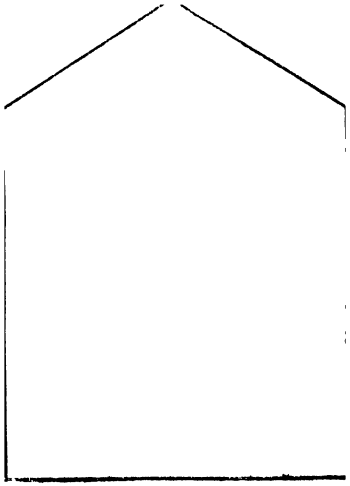


Fig. 1.

flattened, to some extent. The puncheon then presents an appearance represented in Fig. 2.

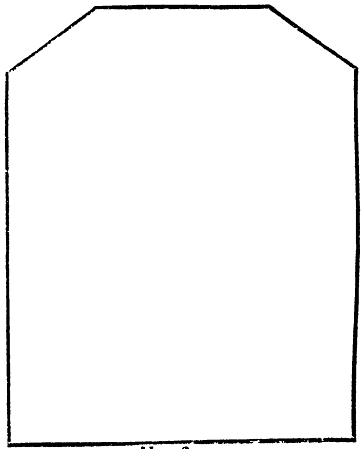


Fig 2.

The compression of the soft steel of the puncheon by the stroke of the press has now made the steel obdurate, and another such a blow immediately administered might prove fatal to both matrix and puncheon. It is necessary, therefore, to anneal the latter before placing it again under the press. This annealing is accomplished by heating to redness, and then embedding it, for the purpose of cooling very gradually, in powdered charcoal. This effected, it is brought once again to the press, and placed beneath the screw. In this case it is necessary that the matrix should be placed upon the puncheon, so that the engraved work on each die shall correspond.

The press-screw is now raised as before, the fly-arms being made to rotate several times, and then is made to descend with accumulating impetus, carrying with it a plain round block of steel, which strikes with much force upon the inverted base of the matrix, and drives it, as it were, with a heavy thud into the puncheon. The press recoils from the blow, and is caught in its upward course by the workman. The puncheon and matrix are withdrawn, and now it is found that, as a seal impresses wax, the matrix has impressed the puncheon, and left thereon a perfect copy of itself in relief. The matrix has now done its work, and is carefully deposited in store, whilst the puncheon, as will be seen, is about to commence an active life, and to become the parent of many coining-dies. It is taken again to the lathe, and any superfluous metal which may surround the impression is there removed. Afterwards, it is hardened and tempered, as before described, in relation to the matrix, and is fit for use. The blacksmith may now go to work in right earnest, and cut off short lengths of bar-steel by wholesale. These, as before, he forges into round shape, and they are passed forward to the turning-shop. Turners are prepared to receive and "top" them, as the conical shaping is termed. By dozens they are passed forward to what is very properly named the Die-Multiplying Press. The puncheon is fixed at the foot of the screw as the matrix was before. The *to be* coining-dies are placed one by one in the press, and receive each an indentation from the puncheon by force of pressure, as before referred to. Then the whole batch are annealed, struck again in the press, removed to the lathes, turned to a proper size to fit either of the eight coining presses on the opposite side of the building.

After the coining dies are completed, so far as the transference of the engraving is concerned, they are conveyed, as has been stated, to the die-turning shop. The obverse is then turned to a gauged size, and fitted, after hardening, tempering, and polishing, into a "bolster," in which condition it would resemble Fig. 3, and is ready for coining.

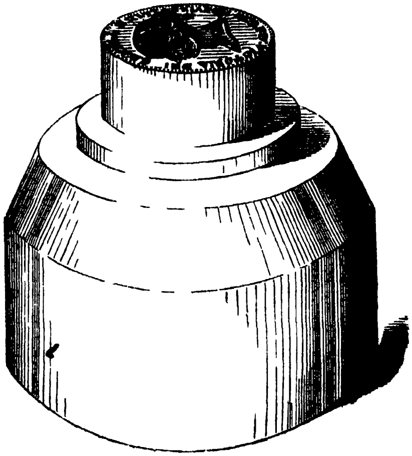


FIG. 3

The reverse, say, of the shilling, would appear when finished like the sketch of Fig. 4, and the collar of steel in which the milling is shown, and which fits exactly over the neck of Fig. 3, is shown in Fig. 5.

Imagining the reverse to be fixed in the upper part of a stamping-press, and the bolstered obverse in the lower part, the steel-milled collar would be made to surround the blank piece of money at the moment that the upper die fell upon it, and hus the two sides of the blank would be impressed at the moment that the milled collar mounted its edge.

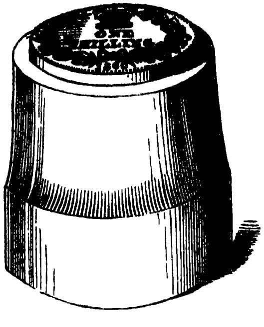


FIG. 4.

A puncheon of good steel will last many years, and, carefully used, give impressions to many thousands of coining-dies, whilst each pair of the latter will stamp, on the average, forty or fifty thousand coins. Of course, precisely the same *modus operandi* is pursued throughout with regard to the production of design, matrix, puncheon, and coining-dies, for the execution of the *reverses* of coins as for that of the *obverses*, to which latter, for the sake of lucidity, these remarks have been confined.

Apropos to the question of the duration of puncheons, it may be stated that, in getting up coining-dies for sovereigns, only one puncheon has been used since the accession of her Majesty Queen Victoria in 1837, and yet between that date and now at least fifty millions of those attractive and very useful pieces of money have been coined at the Royal Mint. Independently of the economy of this system of die-multiplying, which is pursued at that place in the manufacture of all dies, it has the advantage of insuring uniformity of appearance among all the coins of each denomination. If each coining-die were engraved separately, the artist would inevitably fail in making them exact copies of each other, just as a painter would fail in creating duplicate portraits precisely alike.

Mint. JOSEPH NEWTON.

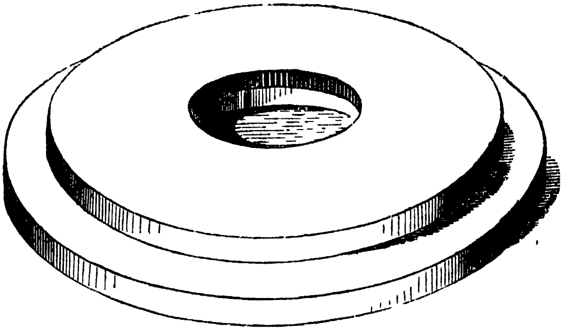


FIG 5.

DESMIDIACEÆ, OR DESMIDIEÆ.

THE readers of RECREATIVE SCIENCE in general are much too keen in the pursuit of knowledge to be frightened away from an interesting subject because a paper (when it cannot be helped) is headed by one or two hard words; I trust, therefore, that my readers will be intrepid enough to proceed, regardless of the repulsive vanguard which stands at the head of the present article. Let them simply pronounce with distinctness the syllables Des-mid-dy-a-she-ee, sounding the isolated vowels as well as those combined with consonants, and repeating the word two or three times to make it run glibly, and the spell of aversion will be instantly broken by the newly-acquired faculty of fluent enunciation.

The term Desmidiaceæ is a received and recognized improvement on its predecessor, Desmidieæ, which, although it may trip more lightly on the tongue, is opposed to the rules of etymological analogy. A *desmidium* (which we will call a desmid for shortness) is a beautiful organized thing—so styled from δεσμα, *desma*, a chain—which has given its family name to a whole clan of kindred. As from *euphorbia*, a spurge, we have *Euphorbiacea*, the family of spurges, so from *desmidium* we have the family of *Desmidiacea*.

As will be seen hereafter, it would be easy to provide this remarkable family with an escutcheon richly emblazoned with ancestral heraldic bearings, mostly vert, on a field of azure or argent. If they want a motto, I take leave to suggest, "*Parvæ, at non despicandæ*"—"Little we are, but not to be despised." In truth, they are not only small, but microscopic; the very largest only are distinctly visible, as minute green dots, by the naked eye.

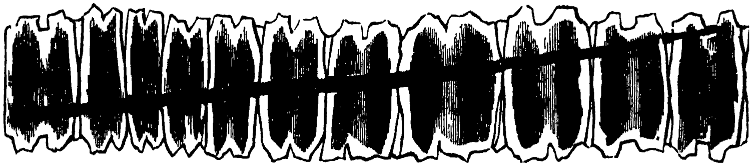
When the possessor of a newly-purchased microscope has taken off the first edge of his curiosity, and has admired and readmired his still small collection of preparations, his ardour in the search after Nature's hidden wonders is apt to flag for want of knowing in which direction to pursue his further investigations. For most pockets the purchase of specimens has its limits, and with most beginners the skill to dissect and manipulate has yet to be acquired. To such I strongly recommend the subjects of the present paper, both as beautiful in themselves and as affording a starting-point for most interesting, and indeed necessary, physiological studies.

The observer is examining a drop of water, which he has probably procured with the expectation of finding in it animalcules only; he will, perhaps, be surprised by the discovery of grass-green crescents, of clusters of emeralds pressed together into a regular form, of elegant green wands inclosed in crystal sheaths, or of bits of something which look like fr gments of the horns and limbs of insects, or of strange insect-like beings in an entire state, only that they are one and all of a brightly transparent verdant hue. He will ask himself what they can be? I will answer him at once that they are DESMIDS, a family of Confervoid Algæ.

The Desmidiaceæ are a tribe of minute plants, of a grass-green colour, all inhabitants of fresh-water only. One or two species have been taken in slightly-brackish water, but the same species are also found in localities from the sea. Desmids assume two distinct varieties of form: thread-like or filamentous, made up of joints something like the vertebræ of an animal's backbone; and single isolated cells, called *fronds*, evidently divided into two symmetrical joints or segments, which communicate with each other internally. These, when once beheld, can hardly ever be mistaken for anything else. Several bear a rude resemblance to the two cotyledons or seed-leaves of a plant, such as a radish or a cucumber, just as it is starting out of the ground.

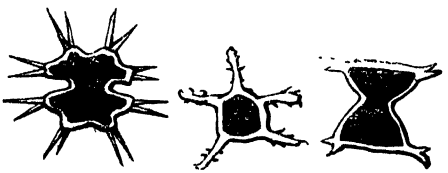
All the desmids are gelatinous, which greatly adds to their brilliancy. In some the mucus is condensed into a well-defined glassy sheath; in others it is more attenuated, and the fact that it forms a covering is discerned only by its preventing the contact of the coloured cells. In general its quantity is merely sufficient to hold the fronds together in a kind of filmy cloud, which is dispersed by the slightest touch.

It appears to the writer of this that a serious debate whether desmids are animals or vegetables, can only have been raised by persons strongly prejudiced by previous notions. The proper station of the Diatomaceæ may be allowed to be considered as doubtful; it may be conceded that they have as much right to a place in the animal as in the vegetable kingdom, although the contrary is now the prevailing idea. With the Desmidiaceæ it is otherwise. Not to mention their very characteristic herbaceous hue, few observers have seen any approach to voluntary motion, not even so much as is displayed by the sensitive plant or the stamens of many flowers, to avoid all comparison with other microscopic plants, such as volvoxes and oscillatorias. The writer of this, with good instruments (Amadio's), has looked out in vain for any signs of life expressed by algæ or water-weeds is afforded by the presence of starch, which, be it remarked, is not an animal product. Meyen found many specimens of Closterium in which the whole interior substance was granulated, and all the grains gave with iodine a beautiful blue colour, the test of their nature. Further, the



Desmidium Swartzii.

motion; his desmids have always remained as quiet as a dish of fresh-gathered mushrooms. What Ehrenberg saw, or dreamt that he saw, of feelers protruding through apertures in the extremities of *Closteria,* was simply a phantasmagoria played off within his own proper brain. There may be a feeble shadow of animal-like form in a certain few of the Desmidiaceæ; *Desmidium* itself has been compared to a tape-worm, *Staurastrum* to an insect sometimes furnished with arms as if for the purpose of seizing its prey. We have a *Cosmarium,* which has been named *tetrophthalmum,* or four-eyed; a *Xanthidium* which is *octocorne,* or eight-horned; one *Staurastrum arachne,* or spider; and another, *S. avicula,* or little bird. The likeness is about as faithful as that which



Xanthidium octocorne. Staurastrum arachne. Staurastrum avicula.

flowers of *Aquilegium* and *Tropæolum* bear to an eagle and a canary-bird.

A conclusive proof that the desmids are

Desmidiaceæ resist decomposition, exhale oxygen on exposure to the sun, preserve the purity of the water containing them, and when burned do not emit the peculiar odour so characteristic of animal combustion, are other facts respecting this family which, taken singly, might have less value, but in their combination furnish most important evidence all tending to one conclusion.

For what is known of the reproduction of desmids the reader must himself search first the published accounts, and then the grand book of Nature, judging calmly, and watching for any new light that may gleam from the original illuminated page. A fresh pair of eyes applied to a subject will sometimes catch phenomena and draw inductions which would have escaped an older and less inquisitive observer. I will merely indicate "the swarming process," common to other algæ, as one of the most astonishing sights which the microscope has to offer. "No one," as Ralfs observes, "can witness the occurrence for the first time without being startled, and almost led to doubt the evidence of sight. Such movements are so contrary to our ordinary experience of vegetable life, that we involuntarily hesitate to admit their compatibility with it; and, on the Continent, many eminent naturalists, unable to find a satisfactory explanation, consider that, in this stage, the zoospores are really animals, and do not acquire their vegetable nature until a subsequent period. This opinion never obtained countenance in this country; yet a Berkeley did not esteem its refutation unworthy of his pen, and a Harvey thought it necessary to record his dissent from it, and his belief that the phenomenon must be regarded as a 'strictly vegetable peculiarity.'"

It is far from clear how Desmidiaceæ are produced in newly-formed collections of water. They have been found in a water-butt standing in a yard remote from any stations of their family-friends, and deriving its water from the clouds alone. How came these algæ there? The theory of spontaneous generation (although it has lately found a zealous advocate in M. Pouchet, of Rouen) may be safely put on one side as inadmissible. Instead of having recourse to it, it is much more philosophical to acknowledge that there are mysteries in Nature which we cannot penetrate.

It is a curious and a hitherto unexplained fact that many desmids will not appear in the same pool for two successive years. One year, a species will be abundant, and produce a plentiful crop of sporangia; notwithstanding which the following year not a single specimen will be found. Still too many exceptions to the rule are met with to justify any certain conclusions, although, as a general fact, the singular phenomenon holds good.

Desmidiaceæ are far from rare, and may be found by the student without difficulty; yet they have their peculiar localities, in which alone they can be sought with any chance of success. As they are unattached by a root and are very minute, they are rarely gathered in running streams; nevertheless, interesting specimens may occasionally be obtained where the current is so sluggish as to permit their thin retaining mucus to elude its force. In small shallow pools that do not dry up in summer they are most abundant; hence, pools in boggy places are generally productive. The Desmidiaceæ prefer an open country. They abound on moors and in exposed places, such as small ponds on bleak commons or high table-lands, but are rarely found under shady woods or in deep ditches. To search for them either in brackish or in turbid waters is useless; such situations are the haunts of animals and of animalcules proper, not the habitats of Desmidiaceæ. The waters in which the latter are present are always clear to the very bottom. M. de Brebisson, whose authority is of the highest, informs us that in France calcareous districts, which are so favourable to diatoms, are very unproductive of Desmidiaceæ. The same thing, doubtless, occurs in England.

The filamentous species often occur in the water in considerable quantity, and, notwithstanding their fragility, can generally be removed by the hand. When they are much diffused in the water, Ralfs's directions, which I abbreviate, are as follows:—Take a piece of linen about the size of a pocket-handkerchief, lay it on the ground in the form of a bag, and then, by the aid of a tin box, scoop up the water and strain it through the bag, repeating the process as often as may be required. The larger species of *Euastrum*, *Micrasterias*, and *Closterium* are generally situated at the bottom of the pool, either spread out as a thin gelatinous stratum, or collected into finger-like tufts. If the finger be gently passed beneath them, they will rise to the surface in little masses, and with care may be removed, and strained through the linen as above described. At first, nothing appears on the linen except a mere stain or a little dirt; but by repeated fillings-up and strainings, a considerable quantity will be obtained. The water passes through the linen, from which the specimens can be scraped with a knife.

D. S. E., M.A.

METEOROLOGY OF NOVEMBER.

FROM OBSERVATIONS AT HIGHFIELD HOUSE OBSERVATORY.

Year.	Mean Temperature of the Air. Degrees.	Mean Temperature of the Dew Point. Degrees.	Mean Pressure of the Air. Inches.	Mean Amount of Cloud. (0—10).	Number of Rainy Days.
1846	45·6	41·9	29·657	6·9	8
1847	45·9	41·5	29·852	6·9	15
1848	42·4	37·9	29·778	6·3	17
1849	39·8	37·5	29·709	6·3	18
1850	44·0	41·1	29·689	6·1	18
1851	36·4	32·6	29·794	6·0	13
1852	44·7	41·3	29·477	7·8	24
1853	38·9	35·6	29·926	8·1	10
1854	39·7	36·1	29·660	7 0	20
1855	41·1	33·8	29·867	8·7	13
1856	40·6	36·5	29·890	6·3	13
1857	43·9	40·9	29·978	8 7	16
1858	39·9	36·2	29·759	7·6	8
1859	40·4	36·6	29·774	6 7	13
Mean	41·5	37·8	29·771	7 1	15

The mean temperature of the last fourteen years for November is 41·5°, the range in the mean temperature being from 36·4° in 1851 to 45·9° in 1847—a difference of 9·5°. The lowest means occurred in 1849, 1851, 1853, 1854, and 1858; and the highest in 1846, 1847, 1850, 1852, and 1857.

The mean temperature of the dew-point of the last fourteen years for November is 37·8°, the range being from 32·6° in 1851 to 41·9° in 1846—a difference of 9 3°; the lowest means occurring in 1851 and 1855, and the highest in 1846, 1847, 1850, 1852, and 1857. The temperature of the dew-point was in 1855 as much as 7·3° below that of the temperature of the air, and in 1849 only 2·3°; the mean difference being 3·7°.

The mean pressure of the last fourteen years, for November, is 29·771 inches, at 174 feet above the mean sea-level, ranging between 29·477 inches in 1852, and 29·978 inches in 1857—a difference of 0·501 of an inch (or half an inch). To reduce these readings to the sea-level, it is necessary to add 0·192 of an inch, when the mean temperature is as low as 36·4°, and 0·188 of an inch when it is as high as 45·9°, as in 1847; then the mean pressure, reduced to the sea-level for November for the past fourteen years is 29·960 inches.

The mean amount of cloud for November for the past fourteen years is 7·1 (or nearly three-fourths of the sky overcast with cloud). The amount ranging between 6·0 as in 1850 and 1851, and 8·7 in 1855 and 1857—a difference of 2·7°, or a quarter of the whole sky.

The mean number of rainy days in the last fourteen years for November is 15, ranging between 8 in 1846 and 1858, and 24 in 1852—a difference of 16 days. The years of but little rain are 1846, 1853, and 1858, and of much rain, 1852, and 1854.

November is famous for the vast number of meteors, especially about the epoch of November 12th to 14th.

E. J. LOWE.

ASTRONOMICAL OBSERVATIONS FOR NOVEMBER, 1860.

THE Sun is in the constellation Scorpio until the 22nd, and then in Sagittarius. He rises in London on the 1st at 6h. 56m. a m., on the 10th at 7h. 12m., on the 20th at 7h. 29m., and on the 30th at 7h. 45m. p.m.; and sets in London on the 1st at 4h. 31m., on the 10th at 4h. 16m., on the 20th at 4h. 2m., and on the 30th at 3h. 53m. He rises in Dublin on the 11th three minutes later than in London, and sets six minutes earlier. He rises in Edinburgh on the 7th six minutes later than in London, and on the 20th thirteen minutes later; setting on the 21st twelve minutes earlier than in London.

Length of day at Dublin on the 19th, 10h. 14m.; and on the 26th, 9h. 47m.

Length of day at Edinburgh on the 27th, 9h. 29m.

Day breaks on the 3rd at 5h. 13m., and on the 24th at 5h. 33m.

Twilight ends on the 4th at 6h. 22m., and on the 29th at 5h. 57m.

Length of day at London on the 8th is 9h. 12m.; at Dublin on the 10th, 8h. 49m.; at Edinburgh on the 16th, 8h. 3m.

The Sun reaches the meridian on the 1st at 11h. 43m. 42s.; on the 10th at 11h. 44m. 7s.; on the 20th at 11h. 45m. 55s.; and on the 30th at 11h. 49m. 2s.

The Equation of Time on the 1st is 0h. 16m. 18s.; on the 10th, 0h. 15m. 53s.; on the 20th, 0h. 14m. 5s.; and on the 30th, at 0h. 10m. 58s. before the Sun, or subtractive.

Day breaks on the 10th at 5h. 13m. a.m.; on the 19th at 5h. 25m.; and on the 29th at 5h. 39m.

Twilight ends on the 3rd at 6h. 24m. p.m.; on the 13th at 6h. 11m.; and on the 22nd at 6h. 1m. p.m.

Length of day on the 7th, 9h. 14m.

New Moon on the 13th at 12h. 36m. a.m.

The Moon is full on the 28th at 11h. 37m. a.m.

The Moon is at her least distance from the Earth on the 11th, and at her greatest distance on the 22nd.

Mercury is in Scorpio, and most favourably situated for observation at the commencement of the month, reaching his greatest eastern elongation on the 7th; rising on the 2nd at 9h. 18m. a.m., on the 17th at 9h. 18m., on the 27th at 7h. 43m.; setting on the 2nd at 5h. 6m. p.m., on the 17th at 4h. 50m., and on the 27th at 4h. 5m. p.m.

Venus is in Virgo, and still a brilliant object, and presents a gibbous phase; rising on the 2nd at 2h. 48m. a.m., on the 17th at 3h. 27m. a.m., and on the 27th at 3h. 55m. a.m.; setting on the 2nd at 3h. 20m. p.m., on the 17th at 2h. 58m. p.m., and on the 27th at 2h. 37m. p.m.

Mars is in Capricornus at the commencement, and in Aquarius at the end of the month. Its form is gibbous. Rising on the 2nd at 2h. 6m. p.m., on the 17th at 1h. 23m. p.m., and on the 27th at 12h. 53m. p.m.; setting on the 2nd at 11h. 8m. p.m., on the 17th at 11h. 6m. p.m., and on the 27th at 11h. 5m. p.m.

Jupiter is in Leo, and a very conspicuous object. It is situated about 1° N. of the star Regulus. Rising on the 2nd at 11h. 41m. p.m., on the 17th at 10h. 49m., and on the 27th at 10h. 14m. p.m.; setting on the 2nd at 2h. 19m. p.m., on the 17th at 2h. 23m., and on the 27th at 12h. 46m. p.m.

Saturn is also in Leo. Rising on the 2nd at 12h. 56m. a.m., on the 17th at 11h. 58m. p.m., and on the 29th at 11h. 22m. p.m.; setting on the 2nd at 2h. 48m. p.m., on the 17th at 1h. 52m. p.m., and on the 27th at 1h. 14m. p.m.

Uranus is in Taurus, and favourably situated for observation. Rising on the 2nd at 5h. 42m. p.m., on the 17th at 4h. 41m., and on the 27th at 4h. 0m. p.m.; setting on the 2nd at 10h. 0m. a.m., on the 17th at 8h. 57m. a.m, and on the 27th at 8h. 16m. a.m.

Eclipses of Jupiter's satellites visible at Greenwich:—On the 9th, at 1h. 9m. 35s. a.m., 1st moon disappears. On the 10th, at 12h. 20m. 55s. a.m., 3rd moon disappears. On the 10th, at 3h. 51m. 21s. a.m., 3rd moon reappears. On the 15th, at 2h. 10m. 44s. a.m., the 4th moon disappears. On the 16th, at 3h. 0m. 41s. a.m., 1st moon disappears. On the 17th, at 4h. 18m. 34s. a.m., 3rd moon disappears. On the 30th, at 1h. 59m. 45s. a.m., 2nd moon disappears.

Occultations of Stars by the Moon:—On the 1st, κ Tauri (5½ magnitude) disappears at 6h. 18m, and reappears at 6h. 41m. p.m. On the 26th, ε Arietis (4½ magnitude) disappears at 8h. 47m., and reappears at 10h. 4m. p.m. On the 27th, No. 27 Tauri (4th magnitude) disappears at 7h. 38m. p.m. On the 27th, No. 28 Tauri (5½ magnitude) disappears at 7h. 39m. p.m.

The variable star Algol arrives at its times of least light in the evening; on the 4th at 11h. 36m., on the 7th at 8h. 25m., on the 27th at 10h. 7m., and on the 30th at 6h. 56m.

Stars on the Meridian:—On the 16th, α Pegasi souths at 9h. 21m. 37s. p.m. On the 19th, β Ceti souths at 8h. 40m. 16s. p.m. On the 26th, α Arietis souths at 9h. 35m. 16s. p.m., and on the 28th, α Ceti souths at 10h. 22m. 55s. p.m.

The November epoch of meteors occurs on the 12th to 14th. E. J. LOWE.

Highfield House Observatory.

THE MICROSCOPIC OBSERVER. NOVEMBER.

MOSSES.—During the winter months the majority of the British Mosses attain their fullest development, and in the richness of their verdure, and their various modes of fructification, compensate us for the general torpor of the vegetable kingdom. When the meadows have no grass, the trees no leaves, and the wayside banks no flowers, there are emerald velvety tufts in abundance on banks and ruins, and most especially on sandy barren wastes. Botany and microscopy may well go hand in hand among the mosses, which offer a very distinct class of subjects for observation, all of them surrounded with associations of the most agreeable kind. The seasonal growth of the British mosses is only just now commencing, and there will be very few in fruit till next month. Nevertheless, students of muscology must now buckle on their armour, make up lists of desiderata, and determine where and when to seek specimens of their favourite arborescent pigmies. The mosses are certainly entitled to the place assigned them in the accepted systems of classification. They have real leaves, real roots, and real flowers, after a certain fashion, and must stand at the head of those families whose marriages are unseen; that is, the *Crytogams*, the lower ranks of which comprise the lichens, the fungi, and the algæ. Generally the leaves of mosses are arranged spirally, and are awl-shaped. In the *Hypopterygiæ* the leaves are accompanied with stipules. The leaves consist of cells containing chlorophyll, and cells without chlorophyll, and here is the first task for the microscopist to distinguish the leaf characteristics, and give full value to one element in systematic classification. The diversity of the forms of leaves of separate families, and the diversity of leaves on different parts of the same stem, are to be noted with care as distinctions; but the fructification, as might be expected, affords the best and most decisive tests for purposes of distinction and arrangement. As is the case very often among ferns, the barren fronds of which differ considerably from fertile ones, so in some of the mosses the foliaceous structure varies with the production or non-production on it of fructification. Every point of the leaf structure must be taken note of in determining species, and in analyzing by means of specimens the recognized methods of classification. These points determined, the reproductive organs must have attention, and here we meet with evidence of the high position the mosses are entitled to in the class of flowerless plants, in consequence of the distinct sexuality of their inflorescence. The two kinds of organs of fructification are the *antheridia*, or sterile flowers, which consist of minute cylindrical sacs, and the *pistillidia*, or fertile flowers composed of flask-like bodies, each having a membranous covering or *calyptra*, terminated by a long cylindrical funnel-mouthed tube or style. The ripened pistillidium becomes the capsule, which usually opens by a lid, but is sometimes dehiscent. Beneath the lid, and arising from the mouth of the capsule are rigid processes called *peristome*, which are always some multiple of four, those of the outer row being called teeth, and those of the inner row cilia. The capsules are filled with spores. Sometimes the antheridia and the pistillida are found together; at others on different parts of the same plant; and in others on different individuals of the same species. Here, again, are distinctions used as the basis of classification, and the beginner will do well to observe the peculiarities of the fructification in various specimens in these respects, in order to gain familiarity with the various forms presented, even before he can determine a single individual species; in fact, haste to give names to gatherings is antagonistic to the acquirement of a sound knowledge of the principles on which species and groups are founded. The antherids are composed of cellular tissue, filled with minute cellules, which escape by the bursting of the apex of the sac; and these cellules exhibit a fibre coiled in their interior, which circulates rapidly, and after a time breaks out of its cellule, and undergoes a rotary motion in water under the microscope—a most interesting and engaging subject for observation. The antherids are of course regarded as male organs, and the pistillidiums as female organs. Of other peculiarities in the structure of mosses we shall speak next month, meanwhile the student may elect whether to investigate them as physiological studies, and determine by the help of the microscope the several points in their history which have immediate reference to their growth and increase, or by the use of simple lenses to determine their places in systematic arrangement as a pure question of botany. Muscologists generally combine both studies, and this we recommend; for the subjects that have been examined for the study of cell structures, and the deposit of chlorophyll and the mysterious processes of fructification have also their own stories to tell of their relations to the order of the vegetable kingdom, and when dried and mounted in herbaria, furnish subjects for examination at all seasons very little inferior to those freshly gathered from the breezy hills and rocky solitudes. Mr. Brocas's instructions at page 209 of our first volume will be found invaluable to those who now intend to commence collecting, or to add to collections already commenced.

Objects worth Seeking.—It is not too late even now to hunt for Diatoms and Desmids. Many of the true Algæ are still in beautiful condition, and in boggy places every tuft of sphagnum will yield a prize. We have lately found in the pools along the sea-wall near Tilbury, on the footpath leading from thence to Grays, specimens of Schizonema, Surirella, Pleurosigma, Cyclotella, Spirulina, Closterium, and Zygnema in abundance. Among dead leaves in woods and gardens, and among reeds in marshy places, rotifers and other infusoria may be taken in great variety, and around piers, bridges, and immersed wood-work of all kinds, good collections may be made by following the instructions as to collecting given by Mr. West and Mr. Slack, pp. 71 and 310 of our first volume. Sections of woods made now show the growth of the year with great distinctness, and should be studied by comparison with sections of cork treated with caustic potash. The vascular and cellular tissues in coal can only be advantageously studied by those who are already familiar with the structure of sections taken from living trees. The starch cells of the potato exhibited in section, and treated with iodine, may be compared with the starch cells of wheat, and other grains similarly treated. To show the vesicular character of starch it must be treated with strong sulphuric acid Starch granules from sago, arrow-root, potato and wheat flower are excellent subjects for polarization, and their variations of colour under it are not less pleasing than remarkable. In woody places pezziza now begin to abound, and are to be collected for observation of their cells and spores. *P. furfuracea* is the most commonly distributed, and will arrest the eye by its bright colour when growing on exposed masses of dead wood. Nests of spiders' eggs, and the eggs of many of the lepidoptera may be searched for on palings, among fences, and under the loose bark of trees. Observers who have exhausted their stock of slides should be reminded that a supply of new objects is attainable in a thousand different ways. The pavement of a damp courtyard will furnish hepaticæ and confervæ, and at any seed-shop may be obtained a majority of the seeds most prized for examination of the markings on their surfaces, and dissections of the albumen and embryo. Seeds of mignonette, pimpernel, chickweed, nigella, linaria, gentian, mesembryanthemum, datura, tobacco, petunia, larkspur, snapdragon, poppy, and digitalis are among the most easy to be procured, and may serve to put many a microscope to new uses, which now endures proscription in a dark corner.

Preparation of Foraminifera from Chalk.—The following method, which I have found successful, may be useful to those who live in suitable districts, *i.e.*, on the chalk formation. The surface of chalk cliffs and banks is continually crumbling away by exposure to atmospheric influence, and the coarse powder thus formed is washed down by the rain, and accumulates wherever it meets with a projection or cranny to receive it. A spoonful of this detritus may be put into a vial half full of water, and well shaken, after settling a few minutes the water may be poured off, and a fresh quantity added, shaking up as before. By repeating this, most of the fine powder is removed, and the remainder consists chiefly of the foraminifera and larger fragments. A little of this sediment spread thinly on a glass slide, dried and moistened with oil of turpentine, will show sundry forms of rotalia, etc., at least if the locality is as rich in these remains as the south of the Isle of Wight, where any of the disintegrated chalk-marl about the cliffs will exhibit them in plenty. A power of one or two hundred diameters will be found suitable. It may be added that these organisms are extremely difficult of detection until the turpentine is applied, which, by filling their cavities at once, renders them transparent, and defines their forms. On the other hand, it is advisable not to apply the Canada balsam and glass cover until their presence is ascertained, or needless trouble will be occasioned, if the sample prove unfruitful. There is less risk in this method (of breaking the larger specimens) than when the chalk is scraped to obtain them.—George Guyon
Richmond, Surrey.

Mr. Noteworthy's Corner.

The Wardrobe of the Water Newt.—During this last summer I have kept a few newts in my aquarium, and have been much amused by witnessing on several occasions the manner in which these creatures cast their skins. As I believe that this is not often observed, first, on account of the very short time occupied over it, and, secondly, its most frequently occurring at night, it may be interesting to your readers if I give a short description of what I have noticed. My attention was first drawn to it by one swimming about in a very excited manner, to me apparently trying to escape. Upon looking more closely, however, I observed that it had something attached to its body close behind the fore legs. I then watched it attentively, and found that it was rubbing against the several pieces of stone at the bottom, trying to disengage itself from what I clearly saw was a skin. When the skin was worked by this means very nearly to the hind legs, it drew first one hind leg and then the other out as from a glove, and, turning its head round, caught the skin in its mouth, and drew it off the tail, finishing the operation by immediately swallowing it As I had not noticed the earlier part of the process, I determined to watch closely for another opportunity, which occurred the same day. This newt appeared to be covered with a slight white film. It then commenced swimming about in the same excited manner that I have described the first one as having done, rubbing its head against the side of the glass. The separation of the skin soon took place, first from the upper and lower jaw hanging like a flap, getting the skin well back to the fore legs, one leg and then the other was quickly released, and the skin passed back in the same way as in the former case, only in this I fortunately was able to secure the cast skin, which I floated on to a sheet of paper, spread it out in the water, and found it to be an exact counterpart of the creature, the small toes being perfect. It appeared in the water as though consisting of jelly, and I find that the specimens I have preserved adhere so closely to the paper that it is quite impossible to remove them. The time occupied in this curious operation certainly did not exceed two or three minutes.—CHAS. BERRY.

MEMORANDA.—In addition to the three new planets, of which particulars are given in the next column by Mr. Chambers, we have to announce the discovery of another by MM. Forster and Lesser at the Royal Observatory, Berlin, whilst searching for that previously detected by M. Chacomac in the constellation Cetus.—M. Chatin reports the discovery of iodine in rain-water, and his process is given in the *Repertoire de Chimie*.—M. Knoblauch, in the *Bibliothèque Universelle de Genéva*, establishes an undulatory theory of heat analogous to that held in regard to luminous radiations.—The Geologists' Association, 5, Cavendish Square, London, will meet Nov. 5, at 7 p.m., to hear a paper by the Rev. W. Mitchell, M.A., on Crystallography as applied to Geology.

TELESCOPES OF SMALL APERTURE.—One of Mr. Noteworthy's friends thus records the work accomplished with a telescope of very moderate capacity, as an encouragement to amateur astronomers. With a telescope of only 1½-inch aperture, fitted with a very deep eye-piece magnifying 120 times, a spot on Mars has been distinctly seen. On June 7, at 12h. 45m. at night, R.A. of ♂ being about 20h. 10m. 46s., and of ☽ about 20h. 43m. 20s., the possessor of the instrument saw a dark spot on the N.W. part of the disc, resembling the semi-circular spot figured in Webb's "Celestial Objects for Common Telescopes," p. 107. On July 3rd, also at 11h. 15m. p.m., R.A. of ♂ being 20h. 7m. 39s., and of ☽ 19h. 33m. 23s., he again saw a large spot near the centre of the disc. Seing it noted, however, in the work quoted above that the author had "been repeatedly able to draw them [the dark spots] with my 5½-*feet* achromatic," "Amateur" had great doubts whether the spots were not optical deceptions. But on July 3rd he had an opportunity of verifying his observations with a 5-feet Frauenhofer of 3¾-inch aperture; they were real spots and no deceptions. Mars has been examined several times with the small instrument when the moon has been absent or distant from him, but *no* spots have been discerned then—another verification of a fact well known to astronomers, that certain objects are best seen during moonlight. Mr. Webb says that Saturn's crape ring has been seen, where it crosses the ball, with a 2¼-inch aperture. "Amateur" has, on favourable nights (*e. g.*, Feb. 23, May 23, etc), seen both that and Titan with a 1½-inch aperture and a power of 90. Venus has been seen a great many times this year at, before, and after, noon on various days from May 4 to June 18, and from the middle of August to Sept. 3, with the naked eye.

NEW PLANETS.—On September 19, M. Goldschmidt at Chatillon, discovered a new planet in the constellation Aquarius; at the suggestion of M. Luther, of Bilk, the planet has been named *Danae*, and bears the No. (62)—On September 13, M. Chacomac, of the Imperial Observatory, Paris, discovered a new planet in the constellation Cetus, No. (59).—On September 13, Ferguson, at the National Observatory, Washington, U. S., discovered a new planet in Pisces, No. (60).—It is worth mention that of the nineteen planets discovered during the past four years, not less than eleven have been detected in the month of September, a good proof of the general excellence of that month for telescopic observation. C.

COMET III., 1860.—In a communication inserted in RECREATIVE SCIENCE for August, parabolic elements by Hind are given for this comet. Since that time other similar elements by Auwers and by Villarceau have been published. A recent letter, however, from M. E. Liais, Director of the Olinda Observatory, Brazil, contains the following elliptic elements :—

P.P. . . 1860.	June 15d. 21h. A.M.T.
π	(not given).
☊	(not given).
ι	79° 17′.
q	0·2921.
μ	+
ϵ	0·99724.
α	105·84.
	= 20,308,000,000 miles.
Period	1089 years.

Eastbourne, Oct. 12th, 1860. G. F

RAMBLES OF A CONCHOLOGIST,

IN GUERNSEY AND HERM, CHANNEL ISLANDS.

BEING anxious last summer to enjoy a conchological ramble on some new shore, I turned my thoughts to the Channel Islands, chiefly because they were, as respects mollusca, comparatively novel to me. In conversing with some naturalists, I was rather surprised to find how little was known at home concerning their marine fauna, nor could I obtain any certain information as to what might be expected on those shores, and what might be inspected in collections and museums, in the islands which are locally so near, yet scientifically so distant. I therefore came to the conclusion that I had better at once set out and examine the shores for myself, which I did.

Whichever way we journey to these islands, there is a long and generally trying sea-voyage to endure. Leaving London by the express-train for Weymouth, I tarried there for the night. I called on Mr. Damon, the dealer in shells and fossils at that place, and found that not even he could give me full details of the shells I might expect in the Channel Islands. I seemed rather to be setting sail for a naturalist's *Ultima Thule*, than a dependency of our own Sovereign. The voyage from Weymouth is some hours shorter than that from Southampton, but is quite long enough for pleasure. I was not fortunate in the weather, and, and in consequence, soon became nearly the sole tenant of the deck, which I paced with a man-of-war captain when all our fair fellow-passengers had hidden their charms in cabin and berth, and were no longer visible above the horizon. Who would not rather wish himself a mollusc than a human biped at sea? The one floats calmly and easily on the waves, while they sadly and madly war against the peace and composure of the other. Even the commonest bivalve is a better sailor than the choicest biped, and there were moments in this seven hours' voyage when I would rather have been a mollusc than a man.

But Guernsey shows itself with its fretted, far-stretching, perilous rocks, and in due time we behold the old town rising up out of the sea, and set upon a hill, while Castle Cornet stands forth prominently on its almost insular rock of reddish gneiss, and attracts our attention, not by its architecture or extent so much as by its historic associations, respecting which the guide-books will tell you as much as you will care to know. The fall of the tides here is so great, varying from thirty-four feet and upwards, that the steamers often depend upon boats to land their passengers. Into a boat I descend with boxes and baggage, and strive to reach the pier amidst a commotion of men, and women, and waves, and travelling gear, which again causes me to envy the quiet mollusc who has but one box, which he always carries upon his back, and one vessel in which he always sails to the end of his voyage:—

> "Yes, it were sometimes even well
> To be a sailor in a shell,
> And only touch upon the shore
> When life's long voyage shall be o'er.
>
> How easy onward still to float
> In one's own well-adapted boat,
> And ever feel one's self at home,
> Upon the billow's restless foam!"

And now that I am located in that delightful locality, Park House, the New Ground, Guernsey, who is to tell me everything about the shells and products of the sea-shore hereabouts? Surely there is a museum? There is a mechanics' museum; but it is closed, and in vain I attempt an entrance on several occasions. Only after a three weeks' sojourn do I find the door fully open to me by the aid of a member's key. Once open, I discover in an upper room a very good and even choice collection of local shells, but only after I have previously wandered over the beaches and explored the coasts. Is there no lover of conchology resident in the island? There is one, but he is out of it, at present, and his collection cannot be seen. Here then I am, thrown upon my own resources and conjectures, but determined to explore for myself.

The common people at Guernsey care for their fish, but not for shells. Every Saturday you may walk through a fish-market not often surpassed. I saw twenty black marble slabs lining a long hall, and on them were placed all the rich produce of the adjoining seas; except only the best fish, which so soon as caught are despatched to England, and are probably sold at Southampton or Billingsgate before market-day at Guernsey. Huge crabs, however, and crayfish remain, and crawl slowly on the Saturday morning over the black marble slabs, where they are criticized by would-be purchasers. Soon as the bargain is struck, away goes the crab or the cray-fish into wicker-basket, or, it may be, is held in the hand of the working-man. I have watched with some interest one and another of the Guernsey men mounting the hundred and twenty steep steps called "Constitution Steps," (and they do indeed try the constitution, even of conchologists), or the hundred and fifteen, called "Clifton Steps," with a monstrous crayfish in one hand, putting out his feelers very feebly, and submitting to his captor's grasp with an evident disposition to become the captor and grasper in his turn, if only he had an hour or two of sea-bathing to restore his strength. Limpets, too, are abundant, and apparently readily sold and eaten, the common cockle not being so plentiful here as on some other coasts. Occasionally I saw in the market a large echinus or two, and these were commended to me as "good eating." Wishing, however, only for the shell, and not wishing the trouble of clearing out its tenant, who is generally very unwilling to quit his tenement, even when an execution is put in, I left the echinus to any dainty purchaser of the prickly prize.

Guernsey itself is not a good place for the conchologist as respects beaches. Composed as it is of granite and gneiss, its shores are, for the most part, rock-bound, and far from sandy or shelly. You may dredge off the coast, and I purposed to do so, but upon meeting at last with an amateur conchologist, he assured me that I should probably not be repaid for my dredging. In truth, dredging is at all times a very uncertain pursuit, and it chiefly repays the collector at the commencement of his work, when common shells are uncommon to him, and when he requires his drawers to be filled with the more usual products of the ocean. It must, of course, happen that the commonest shells will come up continually in the dredge, and the rare shells but seldom. The fisherman whose boat you take, together with himself, is well pleased to see you bringing up only oysters; for they suit his market, if not your cabinet. When I finally met with Dr. L——, *the* conchologist of Guernsey, he assured me that the only thing he had caught on his last dredging expedition was a cold. It is, however, true that his own fine collection of local shells was chiefly obtained by his own dredgings, extending through a series of years. The mere casual inspector of such a collection, all contained in a small drawing-room cabinet of neat drawers, would be entirely ignorant of the labour (though labour of love), and untiring research which it represents. At the close of this paper I shall give a list of the shells obtained in the course of many years by this conchologist in the Channel Waters.

There is a small beach, however, hereabouts, which is a locally famous and favourite one. It lies on the coast of a little island opposite Guernsey, and apparently, when the sun shines brightly, just within easy reach of the latter. Yet it is three miles distant, and these three miles, in certain contingencies, may become equal to twenty in a steamer. This little island is Herm, hardly known even by name to Londoners, or, perhaps, Englishmen in general, and, in truth, hardly known to myself, until I determined to land upon it. I am, then, to be imagined as now bound for a day at Herm. But how am I to reach it? No regular water conveyance plies for it. I must hire a boat, and this I do. Fortunately I have the company of a Guernsey official, well knowing the island, and well known in it. He has business to transact there; in fact, to negotiate the sale of the whole island, and hence his fellowship is desirable. He has no fancy for shells, but much for shrimps, and each of us can separately pursue his sport at pleasure.

Tom Purday's boat is ready. Shell-seeker and shrimper are on board with their implements, and we are about to push off, when down runs a lad and cries out to Purday, "Hold hard, here's a lord a-coming with you, a great lord!" Shoreward we look, and sure enough an elderly gentleman is making his way towards us with a lady on one arm and a dog in the other—of course the lady's dog. All now embark, the dog reluctantly. Off we push, and feel we ought to sail safely over, seeing that this little cutter holds a man of rank, a man of science, and a man of office. *Vehis Cæsarem* was Julius Cæsar's word of encouragement to the timid boatman. What might not ours have been? Sundry furtive and inquiring glances are bestowed upon the lord. He is a gentleman of some sixty or sixty-five years of age, not very lordly looking, not very softly spoken. I venture a word or two, but am not encouraged in my attempt to be respectfully social. The lady addresses a word or two to me, and in that direction I find my civilities more highly appreciated. The official volunteers a sentence to the aristocrat, but is at once extinguished without a spark of hope. Tom Purday tries his tongue, but he had better have kept to his oar. After all, it seems there is most community of feeling between the lady and myself, seeing we are both bound for the same object as well as the same island. She has a little basket for shells, but it is manifest she only intends to conchologize in a lady-like manner. As to the dog, he looks up meekly at his mistress, and evidently means to indicate his preference for the drawing-room sofa and the soft hearth-rug in —— Square. Wind and tide being for us, we soon make Herm, and land upon the little but invaluable pier in due order of rank, the great unknown lord first, then his lady (the dog with the lord), then the man of office, then the man of science—an instinctive feeling prompting him to remain where society would perhaps place him—last.

No sooner landed than a fine, tall, sailor-like man, of forty-five or so, approaches the official. "Stephen, how are you?" cries he, grasping Stephen's hand like a vice. "Servant, sir," exclaims the same person to me, when I am introduced by the official. I am told that this is one of the two present proprietors of the little island. "How many inhabitants have you here, sir?" I inquire. "About forty at present," is the reply. "Well," I remark, "you must all indeed be a happy family. None of the heart-burnings and jealousies of our complex communities can disturb the happy forty here." "I don't know that," is the rejoinder. "What will you say when I tell you that some of us here do not speak when we meet, and that I and Job have not spoken for years?" "What! can this be true?" I ask, being about thereon to moralize. "Quite true," interrupts the Guernsey official, "and I will explain it to you by and by." And he did explain it thus: The island was held by two proprietors, who had entered into a partnership. They were unsuitable for the union, and the issue was, that they could not work together. Here then they are, dwelling in houses about a quarter of a mile apart, with none other between them; having equal lordship over a little sea-girt estate, and yet holding no communication with each other, except the most distant and the most indispensable. What a damaging disproof of Utopian perfectibilities, and the more striking as both parties, when separately known, turned out to be most obliging and apparently amiable persons! Certainly in this, and in subsequent visits, I felt myself indebted to both for civilities which I shall long remember.

But now to the Upper Farm with the official. Here lives Job H——, the second proprietor, a very quiet, kind man, with his equally kind and attentive wife. She has a collection of the island shells. Her husband loving her loves shells, and has obtained these for her. One shell is a Mactra of large size and of some rarity. If we are correct, some conchological treasures here were found by the resident missionary—a very worthy man, who has charge of the forty souls here. Yet, strictly, there are not as many as forty righteous to be found even in Herm. Who would expect to see a public-house here? Yet yonder is one with a flagstaff before the door—let us hope only for the occasional excursionists from Guernsey, who sometimes crowd a steamboat and alight like locusts on this little domain. Let us hope, I say, that only the excursionists patronize the "public." At the same time, those who believe in romantic stories of peaceful, holy, and happy little communities dwelling in harmony on sunlit isles in emerald seas, may learn a little that is not romantic at Herm.

The official talks for a time in Channel Island French to Job and Job's wife. As the tide is not low enough to allow of shelling or shrimping, we must amuse ourselves somehow. Talking concerning the business of selling the island suits the official and Job's wife. Walking suits me, and I perambulate one half of the island, delighted with its marine views, with the opposite mound-like little island of Jettou, hired by an Englishman, at a rent of £30 per annum, for grazing purposes. Before me are the beautiful and romantic aspects of the cliffs of Sark; another and larger island far out to sea, and which, when I afterwards visited it, proved in reality and in detail the fine island it appears to be from Herm, when the meridian sun lights up its steep cliffs and throws its confused rock masses into half shadow, and brings out the bright green of its summer fields, and brightens the clear blue of the flowing ocean, until the whole becomes indescribably picturesque, and would even justify the adjective grand. I may perhaps, on a future occasion, lay before my readers an account of an excursion to Sark.

The tide is half out, the talk is quite out, the conchologist seizes his spade and shoulders his prong; the shrimper shoulders his net; and down we both go to the shell-beach. Job H—— himself will come down after a while, and point out the favourite habitats of a particular mollusc. The principal shell-beach stretches for half a mile along what may be called the back of the island. As we approach it we see the lord and his lady leaving it with basket and dog. We also are attended by a dog from the house we have just left, its name being Mistress, and the name of the lord's dog Hidalgo. Now, Mistress entertaining no other notions of social rank than those which are common to the canine race, viz., liberty, equality, and fraternity, essays an acquaintance with Hidalgo. Both quadrupeds are well inclined, and this casual acquaintance might have ripened into a barking friendship, had not the lord suddenly wheeled round and dealt out with his big foot a vigorous kick to poor Mistress, who instantly turned tail and scampered along the shore, making it re-echo with her complaints, and mingling sad discourse with the musical murmur of the rippling waves. Such was the last we saw of Mistress, of Hidalgo, of the lord and his lady. The latter deserved the shells she got, as did *not* Mistress the kick. Tom Purday had the honour of reconveying the lord, lady, and dog to Guernsey; but we, on shells and shrimps intent, outstayed Purday and his lordly load.

The Herm shell-beach is a favourite resort of the holiday folks, and especially the should-be fairer portion of them, when the "Queen of the Isles," or the "Watt," or some other small steamer, makes a trip for the day. On such occasions from one to two hundred persons may be seen rambling along the shelly strand, with multitudes of baskets, wherein numerous women and children continually cast small shells. It is a curious scene when all these are busily engaged at their amusement in various postures—some not by any means elegant. An eminent conchologist saw such a sight only through a telescope from Sark, and declares that he shall never forget it. What would he have said had he been among these shell-seekers, and on the beach itself, as I was for one long fine day? What exclamations of admiration and exultation did I not hear from dozens of small children and dozens of thin and stout women, and half-dozens of men to their better halves? What a strange jumble of English and Guernsey French! What juvenile screams of delight, what feminine interjections of wonder and warning! At least one hundred baskets were filled that day with all sorts and sizes of shells, chiefly, however, very small ones. At evening time baskets were borne and children led or carried on board the returning steamboat, whereupon a brass band struck up a discordant bray, dreadful enough to raise Triton from the deep, and to madden him into blowing with his conch a blast that shall awe us all—German trumpeters included—into reverent silence! Ubiquitous fellows, these trumpeters. Only a fortnight before I had bribed one of these very flax-haired horn-blowers with a reluctant sixpence to quit my door-step in London! Like Mr. Babbage, I must be preserved from the plague of itinerant musicians. I thought I had escaped them all for one month at least, but here they were on the steamer, and here they are in Guernsey!

Now, however, I am on the Herm beach alone, and I am at liberty to bestow my whole attention upon molluscs and shells. I must say nothing about the anemones and sea-weeds at present. There are shells enough for more than my few hours of opportunity. One long line of them curves round the beach at about high-water mark. Along this line alone do the excursionists pursue their amusement. Of course all the shells on it are "dead shells," that is, their inhabitants died in them, and this generally impairs the brightness and colours of shells. There are limpets of several kinds, and some are rather desirable. The *Patella athletica* may be distinguished by the yellow colour of its tenant when at home. But when at home it is so firmly fixed that it is very difficult to dislodge it. Sitting down upon any one or two spots along this line, you may spend two or three hours in picking up an apparently endless variety of very minute shells, some of rather uncommon kinds, and many of the most attractive shapes and tints. During this one day I basketed hundreds of little elegant univalves and bivales, my chief delay and difficulty consisting in a strong inclination to muse over each one, and to moralize upon the marvellous abundance of material beauty which the hand of Omnipotence has so lavishly scattered here, far away from cities and crowds—only to be observed by diligent use of eyesight—and dwindling away, as it were, from the comparatively large limpet and cardium to the tiny and scarcely tangible phasianella. We talk of populous cities; why, here is a still more populous *shellery*—if I may coin a convenient word. London, the metropolis of the world, has its two or three millions of living beings, and we think, in naming such a number, that we have attained nearly the numerical limits of aggregated life. Well here, on this line of solitary beach, are certainly as many shells as London has human beings, and every one of these shells has had an inhabitant—living, breathing, enjoying itself to the full, each dwelling in its own house, rent-free, and paying no water-rates, although having range of the whole broad ocean, and free to put up where it pleased. The fact is, I mused and moralized so long in this strain, and felt myself so bewildered by attempts to conceive the illimitable extent of life of which these innumerable shells are only a tithe—a mere margin upon the great sea of unfounded vitality—that I did not scan and cull from the mass of minute shells so devotedly as I might have done at other times, when the fit of musing might not be so strong upon me. Yet I took up one and another, wondering and admiring. Here, for instance, is that delicate little bivalve *Lima tenera*, which has so struck even the vulgar fancy that the Hermites call it the "angel's wing;" not a common shell is this, and how uncommon its fair fragility! But it would be in vain to particularize, even if there be any approach to the truth in the report of a naturalist, that there are at and around Herm upwards of forty genera of shells, and about 200 varieties. This is not my own estimate, but is one given by an anonymous "Naturalist."

But now it is nearly low water, and the tide goes out further this day than commonly. Hence I have selected it for my visit. I hear a step behind me; it proves to be that of Job H——. Now then for the benefits of precise local knowledge, and a favourable introduction to Job! He leaves his farm for a quarter of an hour to aid me. I have already turned up a dozen yards of sand and mud with spade and prong. I have already got some good living specimens of a strong, not inelegant bivalve, the *Artemis exoleta*, and also of the common solen; vulgarly, the razor-shell. But I have not yet obtained that desideratum, the particular living mollusc in the shell of which I am in particular search. Job knows its favourite bit of sand, its marine garden, as it were, which is rather limited. This lies between two rocks below the usual low-water mark. Out to it we go, ankle-deep in water, through muddy pools and over seaweed. We halt upon a reach of fine, whitish, silvery sand. Job curiously scans the moist expanse. He looks for two minute holes close together. One hole alone is useless; that indicates the position of a mere sea-worm, but the two little holes, less than half an inch apart, indicate the creature we are in want of. At last Job meets with the double orifice; instantly he dashes in his spade, and strives to turn up a mass of sand containing the orifices in a moment. But, quick as he is, he is too slow; for no sooner was his spade in than the mollusc became wide-awake, and delved deeper than Job. Another double orifice, and another spadeful, but still in vain, for no shell is espied in the lifted mass. Practice, however, makes perfect, and the next time we discover the double door of the mollusc, Job slips in his spade so swiftly, and delves so deftly, that the little animal is fairly caught up in the mass; and upon turning this over and over, we catch a glimpse of a most beautiful little white shell, and seize upon it with avidity. It has its inmate at home within its folding doors, and what a remarkable inmate it is! I know it at once to be the mollusc of that elegant shell, the *Solecurtus candidus*. This is the very prize I was anxious to secure. It is a very remarkable creature of its kind. It is apparently much too large for its shell (that is, in human fancy), and can hardly keep at home, unless with open doors. It is of a beautiful, slightly tinted, whitish colour. In foreign specimens, Deshayes reports it to be of a brilliant orange colour, and at another time compares its hue with the pulp of an

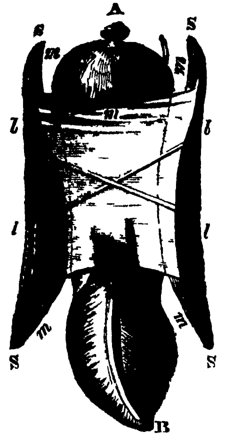


Fig. 1.—Front View.

apricot. This one, however, more resembles a pale peach hue, just tinged with pink, than that of any other fruit. The *mantle* (namely,

Fig. 2.—Side View.

the external, soft, contractile skin, which covers the viscera and a great part of the body like a cloak, hence the term *mantle*) of this mollusc opens wide anteriorly, partly to admit the passage of a very large foot. This is seen in Fig. 1, which represents a front view of the open shell, s, and of the animal, A, inside. The semi-transparent

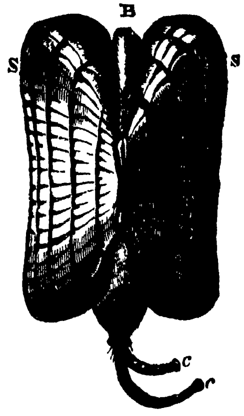


Fig. 3.—Back View.

mantle, *m*, is a little torn away from the inside of the shell, s, at the sides, and stretches across and over the body, thus holding the valves together. The empty space between the inside of the shell and the mantle is shown by the darker shading. The curious glistening crucial ligament, *l l l l*, shines

Fig. 4.

through the mantle, and seems to hold the animal together, in connection with its mantle. It is one of the most remarkable parts, unless we so distinguish the large foot, B, which is seen stepping out of doors, in the front and side views (Figs. 1 and 2). Two very interesting siphonal tubes (*c c*, Fig. 2) stretch out from the upper part of this mollusc. They are united at their bases (where the siphonal mass is large and white), though distinctly separated at their extremities. In Fig. 4 is shown what is very instructive, though I thought it very unfortunate for my specimen, viz., a fracture of the two siphonal tubes, at their point of junction with the siphonal mass, *d*. Thus the orifices are shown at *c c*, and the continuation of them at the point of fracture. The annular or ring-like marks in these siphons show their contractile character, but, as is seen at A in Fig. 1, they are not retractile within the shell, though nearly so within the head of the siphonal mass, and they are about half so retracted in Fig. 3, *c c*. In a fourth and very young specimen I have the end of these tubes tinged with a beautiful crimson.

The function of these siphons is known to conchologists, and can only be briefly explained here. It is, in fact, that of the mechanical tube from which they are named. When the animal has employed its large and strong-foot, and thereby bored its way for self and shell into the sandy bed where it takes up its abode, generally upon a lease for life, it must contrive to live; and it lives by filtering water through its gills. This its pair of tubes enables it to perform through the double hole made in the sand, or mud, by means of the said tubes, or siphons. I suppose the two tubes in the Solecurtus act in the same manner as similar tubes, not very different in structure in other bivalves. As in the instance of the large Mya, one is the inhalent siphon, and the other the exhalent siphon.

In the ordinary state of the mollusc, a current flows steadily into the orifice of the inhalent siphon, while another current rises up from the exhalent tube. The water which enters by the respiratory siphon can only escape by passing through the gills into the dorsal, and so into the exhalent siphon. Thus does the animal live, and not, as sometimes supposed, upon any prey caught between the valves of the shell. Certain particles, organic or inorganic, are, doubtless, conveyed in these currents, and these are collected on the surface of the breathing organ, and carried to the mouth. So far I attribute to the Solecurtus what is known of other similar bivalves; but these are probably some peculiarities in its habits and functions, which only further acquaintance with these uncommon molluscs can enable us to discern and record. I observed, on two occasions, the squirting out of a current from the siphon through one of the holes in the sand before I disturbed the animal. Unfortunately I was not able to keep the four specimens I obtained alive, except for a few hours, and having the misfortune to be delayed in my return to Guernsey, all that I could do when I arrived there was to put them into spirits, in which they now stand before me as subjects for my sketches. Happily their different degrees of contractility have occasioned an instructive variety of position and display. I believe the crucial ligament is rarely so fully and finely displayed as in Fig. 1.

Upon referring to Forbes and Hanley's standard and excellent work, I find the authors stating that "this curiously sculptured shell may be reckoned among our rarer species, notwithstanding that single specimens are usually described in the cabinets of the more active collectors." The shell itself is an elongated oblong, though having a somewhat short appearance as compared with the common solen (hence its name *solen* and *curtus*, short). The valves, though sufficiently convex, are compressed in the middle, and gape strongly at either extremity, the apices of the beaks and the portion of ventral margin immediately opposite them being the sole touching points. "Fine specimens," say Forbes and Hanley, "attain the length of 2¼ inches and the breadth of an inch." Two of my specimens (Figs. 1 and 2) are fully these dimensions. The same authors say that it has been dredged in twenty-five fathoms water off Penzance and the Isle of Man;

also at Bantry Bay, in the South of Ireland, and at Howth and Malahide on the Dublin coast. Dead specimens have been found in the Hebrides, Zetland, and off Caithness. These are all the localities given, and no suspicion seems to have been entertained of the existence of this rare mollusc in the locality I have visited. I cannot find in other English books any allusion to this locality, and the only remark about the animal is, that it is very difficult to capture alive.

It is, however, as well to mention that on a subsequent visit I could not obtain one single specimen, because the tide did not then go out far enough. Let no one, therefore, suppose that a casual visit to Herm will be certainly successful in securing living specimens of the *Solecurtus candidus*. Indeed, I have some doubts whether many more will be easily obtained unless by a residence for a day or two on the island at the precise time of the lowest tides. It should be added that Job H—— is probably about to depart, for the island has very recently been sold to a London gentleman, who, perhaps, may not be so friendly to the incursions of shell and shrimp hunters, as Job and Stephen have been.* Should this meet his eye, let me entreat him to make a regular preserve of the grounds of the *Solecurtus candidus*. Already, I have been told, numerous specimens have been destroyed by idle youths, and I myself found two "young gentlemen" amusing themselves with digging for them, and laying waste this precious marine sporting-ground.

By way of warning, also, let me add that the navigation to and from this little island is dangerous, owing to the multitude of small sunken rocks, especially on leaving the pier. When I returned in the evening of the day I am now speaking of, I was no less time than three hours on the sea in sailing the distance of three miles, for the tide was against us. We had tarried too long at our pleasures, and I thought I should not land at Guernsey that night, so tardy and tantalizing was our tacking and retacking, sailing and rowing.

I am enabled to add a complete list of the Guernsey shells, which I think will be acceptable to conchologists, as I believe it is now made generally public for the first time. It was drawn up by Dr. L——, of Guernsey, for the margin of a local map of that island, and I may publish it the more confidently as I inspected Dr. L——'s collection for several hours, and examined the rarer shells named in this list, which is particularly founded upon his own cabinet, and that upon his own dredgings and diggings.

LIST OF GUERNSEY SHELLS.

1. Teredo pedicellata.
2. Pholas dactylus.
3. „ parva.
4. „ candida.
5. Gastrochæna modiolina.
6. Venerupis irus.
7. Pandora rostrata.
8. „ obtusa.
9. Lyonsia norvegica.
10. Solecurtus candidus.
11. Psammobia costulata, etc.
12. Lutraria oblonga.
13. Cardium aculeatum.
14. „ nodosum.
15. „ papillosum.
16. Lucina borealis.
17. „ flexuosa.
18. „ leucoma.
19. Diplodonta rotundata.
20. Lepton squamosum.
21. „ convexum.
22. „ Clarkii.
23. „ sulcatulum.
24. Galeomma Turtoni.
25. Sphærium caliculatum.
26. Mytilus ungulatus, etc.
27. Modiola phaseolina.
28. „ tulipa.
29. Crenella rhombea.
30. Arca tetragona.
31. Lima subauriculata.
32. „ Loscombi.
33. „ hians.
34. „ tenera (Herm).
35. Pecten furtivus.
36. „ tigrinus, etc.
37. Argiope cistellula.
38. „ decollata.
39. Terebratula capsula(?)
40. Lamopsis pellucida.
41. Spirialis Jeffreysii.
42. Chiton discrepans.
43. Haliotis tuberculata.
44. Rissoa lactea.
45. „ labiosa.
46. „ ulva, etc.
47. Cerithium metaxea.
48. Aclis unica, etc.
49. Murex corallinus.
50. Lachesis minima.
51. Triton cutaceus.
52. Helix revelata (land shell).
53. Syndosmea tenuis.
54. Truncatella Montagui.

Of the above shells several are very small in size, but they are by no means of small interest. Much might be said respecting several of them, which cannot now be added. One or two remarks must close this paper. *Triton cutaceus* (51) is a rare shell in this locality, but a still rarer one is *Triton nodiferus*. One specimen alone is known from

* I see he advertises the letting of the island.—November, 1860.

these waters, and it has occasioned some doubt and disputation as to its locality. I received a note from a conchologist intimating his doubts to me respecting this very shell—the *Triton nodiferus*—which is found at Vigo, but not at Santander (Spain). It was thought that this, and some other shells, had been erroneously introduced into the list of British fauna. I therefore made it my particular business to search out the history of this rare triton, and finally met with the gentleman who had obtained it from the finder. He gave me a circumstantial account of its finding, and pointed me to the shell itself. I cannot therefore doubt that this unique *Triton nodiferus*—unique as respects its British locality—was found near Guernsey, though I did not actually see the person who dredged it up.

From the account I have given of Herm and Guernsey, as respects conchology, it will be seen that the visitor who is *commencing* a collection of British shells may fairly expect to be rewarded by a visit to Herm; indeed he can scarcely select a more promising British locality. But of the rarer shells he may discover none. The *Cardium papillosum* (15) is a very rare shell, and the *Galeomma Turtoni* (24) is a treasure not easily to be grasped. But if he do not procure such shells, he will be delighted with the scenery, on which we would fondly dwell, especially with reference to the southern coast of Guernsey.

If any ladies adorn the party, they will be charmed with the miniature imitations of birds, formed exclusively of the Herm shells, which are on sale at Guernsey, chiefly at a shop near the Elizabeth College. These birds are the most perfect and admirable specimens of conchological ornithology I have ever seen. A complete poultry-yard costs £2 10*s*., and it includes some six or seven cocks and hens, every part of whose exteriors is exactly represented by appropriate shells.

J. R. Leifchild, A.M.

THE COLOURS OF PLANTS.

Few subjects can be more interesting, to observers of Nature, than the investigation of the causes which give colour to those beautiful flowers which line the hedgerows and adorn our gardens. We shall, therefore, devote a few words to explain the subject, as far as science has hitherto unveiled these mysteries of Nature.

The leaves of the plants and the petals of the flowers are composed of a number of little cells, fitting more or less closely together. In the leaf, it is found that these cells contain a substance called chlorophyll, floating in a transparent liquid. This substance, which is supposed to be formed from the carbon of the atmosphere, and which consists of a number of delicate flakes, gives the beautiful green colour to the foliage of the vegetable world. Its existence depends on the action of light; for plants, which are placed where the light is excluded, lose their green appearance, and become blanched. As, however, the green colour is found in the pith and in other parts of the vegetable, from which light is excluded, it seems to be capable of being produced by other actions of the plant, probably by an abundance of hydrogen. The leaf, however, which, owing to the presence of chlorophyll is green, does not always preserve this colour. In some cases, as with the ivy during winter, the leaf becomes dark and almost black; in other cases it becomes white, red, or yellow, producing, in fact, those hues which add such beauty to the autumn woods. In the first case, the ivy, the dark colour seems to be caused by the absence of the liquid in which the chlorophyll floats. As spring advances, and the sap is sent through the veins of the plant, this dark hue is seen to disappear in the neighbourhood of the vessels, and the green colour gradually to spread over the whole surface of the leaf. The white colour seems to be caused by the abundance of the fluid in which the chlorophyll floats; and the other tints, such as the red leaves of the sumach, the yellow and purple leaves of the vine, by the inability of the plant to take sufficient carbon from the air to preserve the former green tints. Botanists consider the leaf to be simply a flower, or part of a flower, undeveloped;* and it is curious to notice how constantly the young leaf, the frail and the dying foliage, produce the colours of the plant. Thus the leaves of the purple cineraria bear this tint on their lower surface. The geranium, when touched by frost, becomes red, leaves of the white grape yellow, those of the dark grape purple.

The colours of the flowers are produced by similar causes. In the cells of the leaves, as we have said, a green substance only is found; in the cells of the flowers, besides those which contain chlorophyll, we find others in which red, yellow, and blue matter exist in a semi-liquid state. The interior cells are for the most part filled with green or yellow matter, and the exterior with red or blue. To these substances all the endless variety of beautiful colours which adorn the flowers is due. In those portions of the petal which are white, the colouring matter is almost absent, and the liquid in which the colour floats is in excess. Again, where its appearance is dark, the fluid is deficient, and the blue or green colouring matter is in excess. Absolute black never exists, for, however dark the colour may seem, a careful inspection will always show the blue or green tints. The orange colour is produced by cells of yellow lying beneath cells of red; the brown by the interior cells of green combining their colour with the upper cells of red. When several rows of cells are filled simply with liquid, and placed over cells containing green or blue, a glaucous appearance is produced. The purples are, of course, combinaitous of red and blue.

An effort has been made to trace all these different colours to modifications of the chlorophyll, and to see in the changing colour of the leaf the laws which produce the variety in the flowers. Besides the green, we have seen that the colouring matter of plants consists simply of three primary colours—blue, red, and yellow. Two of these—the blue and the yellow—are present in the leaf; and, moreover, it has been observed that red is only a common condition of the blue and the yellow; for, whilst blue flowers never change to yellow, nor yellow flowers to blue, both blue and yellow change readily into red. It seems, therefore, that the colouring matter exists in a neutral state in the leaf, and that in the flower it is separated into its component parts, blue and yellow, and that other modifications produce the red colour. A very ingenious explanation has been suggested by M. Marquart. Having dissolved leaves in alcohol, he found that if he treated the substance he thus obtained with water, the green tint became yellow; whilst if he applied sulphuric acid (which has the property of absorbing the water), the green passed into blue. He therefore concluded that, by the addition of water, the chlorophyll became yellow, and by the abstraction of water it became blue. Whether this is to be accepted as a sufficient explanation or not, it is manifest that yellow is the predominant colour of plants growing in the spring, and in moist positions, and that blue is the prevalent tint on dry soils, and in the heats of summer.

It will have been observed that the colouring matter of flowers consists of the primary colours—red, blue, and yellow—colours which, when united, produce white

* Every part of a plant is a modification of the leaf?—Ed.

light. In the case of red flowers, as the scarlet geranium, the colour of the flower is complementary to the colour of the leaf; or, in other words, what the leaf (yellow and blue) wants, to produce white light, is supplied by the flower (red). In no other combination does this occur; for, as yellow is the complement of purple (red and blue), and blue the complement of orange (red and yellow), these relations cannot be produced in plants, one of the elements of which is green. The question therefore arises, What becomes of the light which is lost or absorbed by the plant? The rays of light, when they fall upon a leaf, are white; when they are reflected, we have blue and yellow rays, and a portion of white light. What has become of the red rays? Again, the light which falls upon yellow or red flowers, only gives us a part of what it has received; in the one case the red and the blue is absorbed—in the other case the blue and the yellow. The different colours of white light are known to have different properties. The red rays produce most powerfully heat, the yellow rays yield a greater abundance of light, and the blue rays are most necessary for the germination of the plant. Does Nature, whilst she clothes the lilies of the field with beauty, abstract from the light that principle which is most necessary for the growth of the plant? And is it this principle which denies to us the red flowers in the cold days of spring, but which scatters them with a liberal hand beneath the rays of a summer's sun? HENRY HALL.

WAYSIDE WEEDS AND THEIR TEACHINGS.

HANDFUL IV. CONTINUED.

THE botanical lesson with which we terminated our third Handful of Wayside Weeds, left us looking at the bract of the lime-tree (Fig. 61), and a very distinct and well-marked specimen of a bract it is; but you remember, probably, that many bracts were not by any means so readily distinguishable from the leaves; indeed, that in numerous cases they were, to all appearance, leaves and nothing else, but for the fact of being supplementary to the peduncles or pedicels of the blossoms, as we see in Figs. 53, 69, and 71, even where the flower-leaves or bracts are indistinguishable from ordinary leaves. The transition then is natural from a lesson on bracts to a lesson on leaves.

look around you upon the varied .mmer landscape in England, ry glance over that of the or hedge-row you come to, will give some notion of the infinite variety of leaf forms; and it may seem a formidable task in prospect to acquire a knowledge of them, but the interest will repay the labour, and the latter is not really great when the general rules are mastered which botanists employ to reduce the apparently heterogeneous collection to order and classification. We do not seem to have moved from the vicinity of the lime-trees, so pluck one of its bright green shining leaves; or failing the lime-tree, gather a nettle-leaf (Fig. 72), which will do as well; or, if you fear the sting, look for the red dead-nettle, which will not sting, or for a violet-leaf, or indeed for the first broad-looking leaf you can find. Lest, however, you should not be in the way of any other leaves than those of the present number of RECREATIVE SCIENCE, we furnish you with a specimen (Fig. 72), from which we must learn our lesson. One thing is very evident, that the broad expanded portion or *limb* or blade of the leaf is composed of two

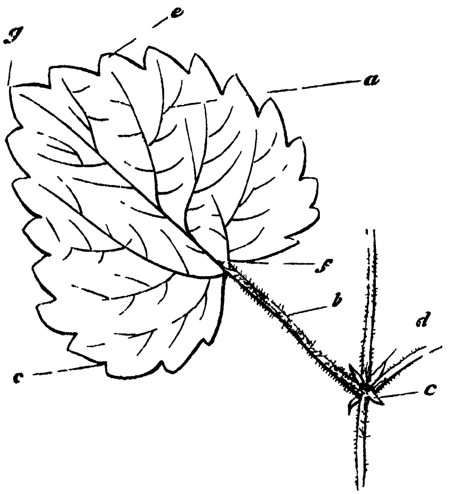


Fig. 72.—Leaf of Common Nettle *a*, Limb or blade; *b*, petiole, *c*, stipules, *d*, axil, *e e*, margin, *f*, base, *g*, apex.

structures, the ribs or veins, and the green pulp lying between. In most leaves one main or mid rib runs up the centre of the leaf, and from this the veinings of the leaf branch out, interlacing with one another. In some leaves, however, there are more than one rib to the leaf, as you may see in the common plantain (Fig. 52), if you either examine the plant itself, or turn to the illustration. Again, as partly exemplified in the lime-leaf, and also in the nettle, other ribs or veins frequently start from the base of the leaf as well as the midrib. This leaf ribbing or veining has much to do with determining the form of the leaf, and you cannot do better than compare its variations in any broad leaves you can gather.

But now take the long thin leaf of grass (Fig. 56), of sedge, or of water iris; or, if you prefer garden flowers, take hyacinth, tulip, or lily of the valley; you will find no branchings in these leaves, nothing but straight lines or veins running all the length of the leaf. You see at once we have our leaves divided into two distinct classes—netted-veined leaves and straight-veined leaves. The former greatly preponderate in our northern regions, the latter occurring only in the form of grasses or small flowering plants; but in the southern and tropical climates this is reversed, and then the straight-veined leaf is found on the loftiest trees, on the palm, the banana, the arborescent if still grassy bamboo, whilst it characterizes also the beautiful or quaint orchideæ. You will find, when we come to our lesson on classification, that these two kinds of leaves mark with great exactness the two great divisions of the flowering and seeding members of the vegetable kingdom.

Let us go back to the leaves with netted

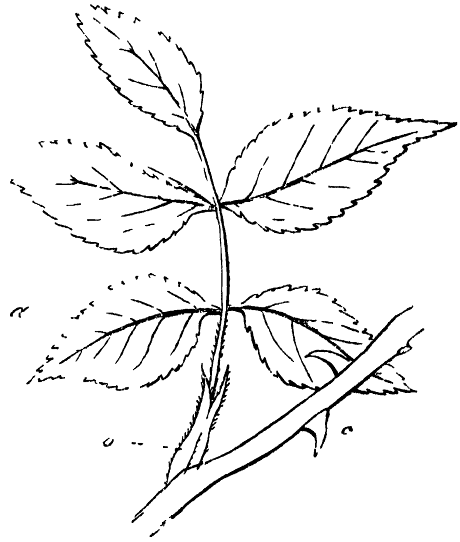


Fig. 73.—Compound Pinnate Leaf of Rose. The segments of the leaf, *a*, ovate, with an acute apex and serrated margin, *b*, stipules; *c*, seta or prickle

veins. We have, it is true, severed them from a mass of straight-veined neighbours; but, even now, when we come to look into them, their number and form seem endless. We do not look long, however, before we find another line of distinction among them-

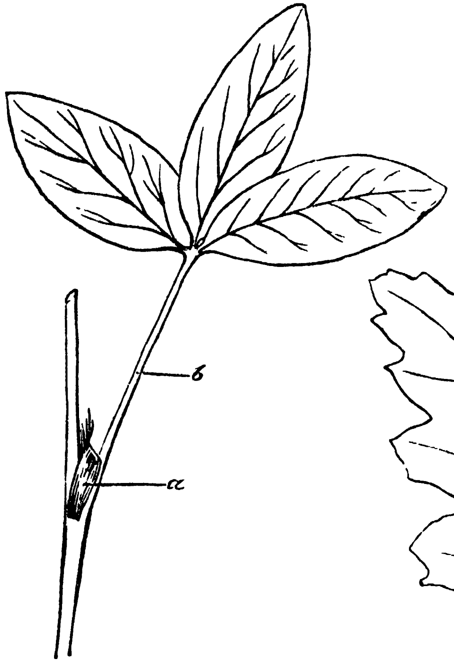


Fig. 74.—Compound Palmate Leaf of Clover. *a*, stipules; *b*, petiole.

selves. You know the leaf of the wild rose (Fig. 73), of the bramble (Fig. 29), of the clover (Fig. 74), of some of our old friends of the umble-bearing class (Fig. 36), and perhaps of the ash-tree, and lastly of the vetch (Fig. 34). Put any or all of these beside the leaf of the oak (Fig. 75), of the bryony (Fig. 76), of the lime; or, to go to more familiar plants, of daisy, or dandelion, or wild geranium (Fig. 77). The difference is evident between the compound or many-pieced leaves of the first set, and the simple one-pieced leaves of the second. We begin with the latter, but do not confine yourselves to the examples we have given you, but collect in as great variety as you can. When you have done so, we doubt not that you will find the majority of the leaves you gather are made up of two parts, the broad blade or limb, or leaf part proper (Fig. 72, *a*), and the supporting stem, or petiole (*b*). In a certain number you will find a third part—or parts, for there are two (Fig. 72, *c*)—at the base of the petiole, called the stipules. In our example, the nettle leaf, the stipules are small, but at the base of the petiole of the compound rose

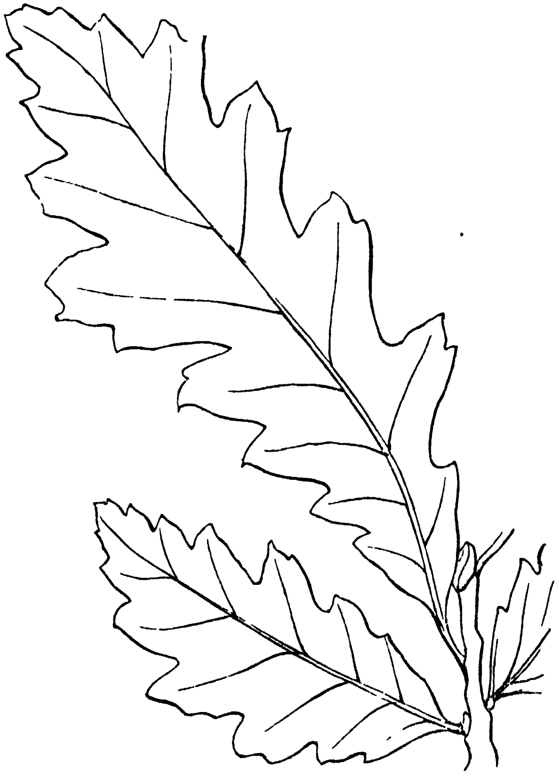


Fig. 75.—Leaf of Oak. Form oblong ovate; the margin sinuate.

leaf (Fig. 73), or in many vetches, and in the clover (Fig. 74), you will find the stipules much more fully developed. The point of junction of the leaf-petiole with the stem of the plant from which it springs (Fig. 72, *d*), is called the axil or axilla, and from the angle formed by the two frequently spring leaves, flowers, or buds (Fig. 69, etc). As the ribs and veins of a leaf give it form, and govern, too, its irregularities, the intervening green pulp, or, as botanists call it, parenchyma, makes up its substance, both being covered over with the skin, or epidermis, of the plant. Much is there to tell of the beautiful and

FIG. 76.—Leaf of common Black Bryony. *a*, blade, or limb, *b*, petiole, *c*, stipule, *d*, axil, *e*, margin, entire; *f*, base, cordate, or heart shaped, *g*, apex, acute.

important functions performed by leaves, through their veins, parenchyma, and epidermis; but we have too much to say of their outside forms to enter into these things now.

It seems superfluous to remind a reader that a leaf has two surfaces, but we do so to direct the attention to the difference in these surfaces in every leaf you examine, that difference being, of course, much greater in some than in others. The chief appendages are hairs of very varied form, from the softest down, or the satiny lustre of the mountain lady's-mantle, to the sting of nettle, which is a glandular hair, or the prickle, or seta, of the rose-leaf or stem (Fig 73), which is a hardened hair. Remember here, that holly prickles, with all their Christmas associations, are not hairs, but the hardened extremities of our old friends the veins.

Remark, again, that a leaf has margin, base, and apex (Fig. 72, *e*, *f*, and *g*), and you have got the general outline of the leaf. But from the margin we get a whole lot of distinctive marks; for it may be entire, as in Fig. 76; serrated, or saw-toothed, as in

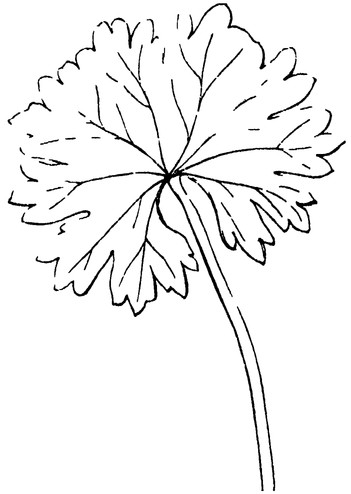


FIG. 77 —Rounded, or kidney-shaped Leaf of common Dove's foot Cranebill, cut in rounded lobes.

the rose leaflet (Fig. 73), or in the lime (Fig. 61, etc., etc.), more deeply cut or toothed, as in the nettle (Fig. 72); or sinuate, that is, cut in a wavy fashion, as in the oak (Fig. 75); lobed, as in the leaf of the common little soft-leaved geranium (Fig. 77); or deeply cut, forming the pinnatifid leaf, as in the common poppy (Fig. 78). The apex of the leaf takes many forms; for, though pointed in the majority of leaves, the form of the pointing varies much, and at times there is no point at all; the leaves being either blunted in some way, or rounded as in Fig. 77, or as in the well-known Indian cress; or kidney-shaped, as in the marsh violet. The base of the leaf, likewise, has many forms; and thus, according to margin, including both base and apex, we get the diversified shapes of foliage, which not only vary so much in different species, but are even so modified in the leaves of the same tree,

"That two were never found
Twins at all points."

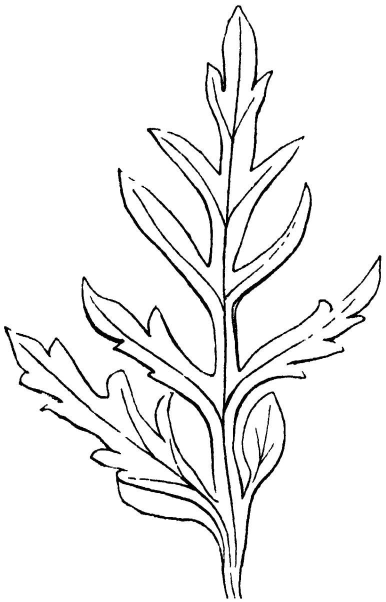


FIG. 78.—Leaf of Corn Poppy, deeply cut, pinnatifid, not compound.

Thus the leaf of the black bryony (Fig. 76) is aptly described as heart-shaped from its base, acute from its apex, and with an entire margin;* that of the lime (Fig. 61) as less distinctly heart-shaped, but with serrated margin. The leaf of the plantain (Fig. 52) is a broad ovate; and each individual leaf of the woodruff (Fig. 45) is lanceolate, or lancet-shaped, but approaching the linear, or line-shaped, leaf which we see in the harebell (Fig. 47), or in the grass (Fig. 56). Each leaflet of the rose (Fig. 73) is ovate, acute, and serrated; of the vetch (Fig. 34) ovate and entire. In the leaf of the poppy (Fig. 78) we find the cutting so deep that it almost approaches the compound leaf, and the same occurs in the leaf of the ragwort (Fig. 44), in which also we see the example of the lyrate leaf, which is, however, still better exemplified in the leaf of the common turnip; and this cutting up into segments, without the leaf being compound, appears strongly in the wild chamomile (Fig. 43). Then we have shield-shaped, and arrow-shaped, and spear-shaped leaves (as in Fig. 71), lobed leaves of all varieties, and many others which it would not come within the scope of these papers to enumerate and illustrate, and which will best be studied from the cullings of the waysides, referring the leaves of each plant to the description given in the Floras.

The rose, the vetch, the ash-tree, have truly compound leaves, that is, are composed of a number of leaflets arranged upon a central petiole, and jointed more or less distinctly to it, forming what is called a pinnate leaf, in distinction from the radiating or palmate compound leaf of the clover (Fig. 74), of the strawberry, etc. etc. The umbel-bearers, among others, offer us a large variety of compound leaves.

You will call to mind that, in describing a perfect leaf, the petiole, or footstalk, was given as one of the parts; but long before this we expect you have discovered that there are many leaves which have no petiole at all, but are directly attached to the main stem. These are called sessile, or sitting leaves. When the attachment is a simple one, when the leaf is not only closely attached to the stem, but is prolonged down it, as you will find in the thistle, it gets the name of decurrent, or running down leaf; or when it more completely envelopes the stem,

* The black bryony, a very common wayside weed in England, found twining among the hedges, is an exception to the rule of netted and straight-veined leaves. It belongs, in everything but its leaves, to the straight veins.

it becomes sheathing, as in the grass (Fig. 56). In the common teasle, the pairs of opposite leaves join, or grow completely round the stem, and then are called connate; whilst a perfoliate leaf is one which the stem seems, as it were, to perforate. Lastly, some leaves appear to have no stem whatever to be attached to, as in our friend the plantain, and then get the name of radical, or root leaves. Whorled leaves are those which are arranged round the stem, as in the woodruff (Fig. 45). As yet the leaves we have been dealing with have all been true leaves, but many plants show, in the first stage of their growth, a leaflet, or pair of leaflets, which are totally distinct in form and appearance from all that succeed them. These first leaves are the cotyledonary, or seed-leaves of the plant. If you have ever planted a lupin-seed, and watched its growth, or carried your horticulture so far as to sow some mustard-seed, you will know what is meant; but if not, you may soon do so, either by trying the above, or using your eyes in your next spring walk, when you will find under every hedge crowds of little seedlings throwing up their first seed, or nursing, leaves, and pushing out from between them their true leaves, as you see in Fig. 79.

One more point connected with leaves, and we have done, fearing almost that you are already tired of us. You have not forgot that in our talk about blossoms, it was mentioned that botanists took distinctive plant-characters from the folding of the

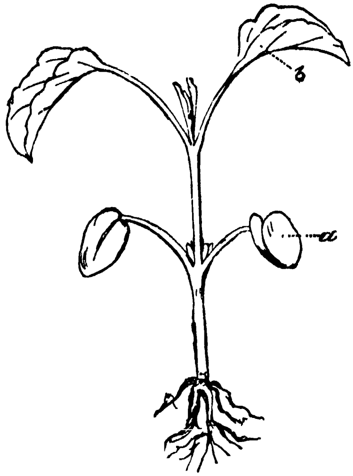


FIG. 79.—Seedling Plant. *a*, cotyledonary, or seed-leaves, *b*, true leaves.

flower in the bud, before opening—from the æstivation, as it is called. In the same way are characters taken from the leaf before expansion—in this case named vernation. It is sufficient here to mention the fact.

SPENCER THOMSON, M.D.

SPICULES OF MARINE ZOOPHYTES.

AMONG the multitude of objects which the microscope has revealed to us, there are few more remarkable or beautiful than the calcareous bodies called spicules, which are found in countless multitudes in the skin and flesh of certain marine animals. These minute objects are all but invisible to the unassisted eye, most of them, when cleared from extraneous matter and mounted on the glass slide, appearing like a little of the finest dust.

It might hardly be anticipated that the skin of a sea-slug would abound in regular forms that seem to be fashioned out of the purest crystal, and in such numbers that a particle of the integument the size of a pin's head contains many scores. When mounted for examination by the microscope, they are usually separated from the investing tissue, and all traces of their arrangement in it are thereby lost; but it has been ascertained that in some species, at least, they are grouped with considerable regularity, and their office appears to be to impart greater strength and firmness of texture, while, in a few cases, they may supply the place of what we might consider more efficient instruments of progression. They are usually imbedded in the skin, in such numbers that it is difficult to get a clear view of their forms until they are cleared from the surrounding tissue, and spread abroad on the glass. This is done by immersing the whole in some solvent which will remove the skin, or soften it so that it can be washed away, leaving the spicules behind. As acids would dissolve the calcareous spicules together with the skin, and thus defeat the object, a strong alkaline solution is used. A portion of the integument is placed in a test-tube, or watch-glass, and a little liquid potassæ is poured over it; the whole is then boiled over a spirit-lamp, being careful that none of it spurts into the eye, and when sufficiently separated it is suffered to cool; the alkali, etc., is then washed away by filling up with pure water several times, allowing the spicules to settle, on each occasion, before pouring off. If to be mounted permanently, they are shaken up, and a drop is placed on a slide and evaporated to dryness, it is then covered with Canada balsam and thin glass in the usual way. They are beautiful objects however they are viewed, but they show to most advantage by "black ground" illumination, which gives them a lovely silvery aspect, or by polarization, when they exhibit the most vivid colours. Fig. 1 shows the spicules of the curious zoophytes, frequent on some parts of the coast, called "sea paps," or "dead men's fingers" (*Alcyonium*). Mr. Gosse describes them as "short thick cylinders, each end dilated into a star of five or six short branches, which are again starred at their truncate ends." He also figures a more elaborate form belonging to the same species. An alcyonium, from the antipodes, showed spicules ranging from 1-200th, to 1-8th of an inch in length; the latter must have been giants of their kind. The well-known sea fan, or gorgonia, so often brought from tropical countries and kept as a curiosity, may be noticed to be covered with a whitish incrustation, this coating is simply the dried flesh of the zoophyte, charged with spicules more or less resembling Fig. 2; the form varying with the species. They may be obtained by boiling a fragment as before directed, when the spicules will fall from it in a shower, leaving the stem black and bare as a winter branch. Fig. 3 shows more regular forms from an allied species, *Muricea elongata*. Spicules of a very elongate figure, and exhibiting a kind of twist, are furnished by the remarkable zoophyte termed the sea pen (*Pennatula*), better

Fig. 1.—Sea Paps (*Gosse.*)

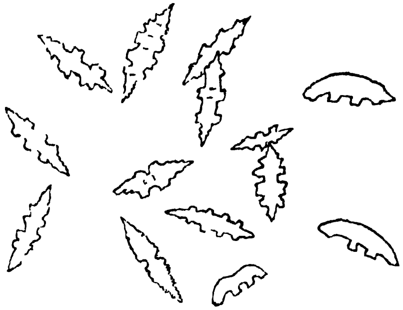


Fig. 2.—Gorgonia (*Mag.* 100).

Fig. 3.—Muricea elongata (after *Carpenter*).

known for its phosphorescent property. One is represented in Fig. 4. The exami-

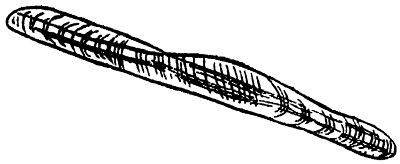


FIG. 4.—Sea Pen (*Hogg*).

nation of very thin sections of the ordinary red coral shows it to consist of an aggregation of spicules, not unlike those of alcyonium. The different species of sea-cucumber, which occur on various parts of our coast, are plentifully provided with these spicules. Mr. Gosse compares them to several dumb-bells soldered together according to a regular pattern;* another form is figured by Carpenter. One of the tribe, *Pentacta pentactes*, is often sold by aquarium dealers. Fig 5 shows some of the forms seen in the

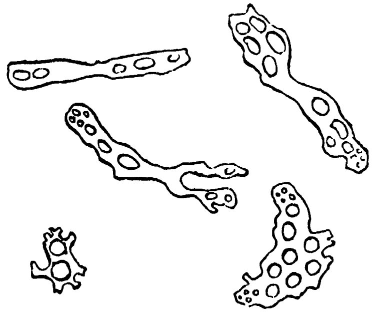


FIG. 5.—Sea Cucumber.

extreme end of a tentacle, snipped off with fine-pointed scissors, and treated with liquid potassæ. The animal takes little notice of the trifling wound thus inflicted, and probably in a short time reproduces the injured member, as its kindred are known to do with their digestive organs, after voluntary parting with the same. The spicules figured are magnified 100 diameters; more symmetrical forms, not unlike the frame of a pair of spectacles, are frequently seen among them.

Closely allied to the sea-cucumbers (*Holothuriadæ*) are the *Synaptidæ*, stated to be common in the Adriatic and Mediterranean Seas; the slide from which the spicules in Fig. 6 are drawn, however, is labelled "*Mer-*

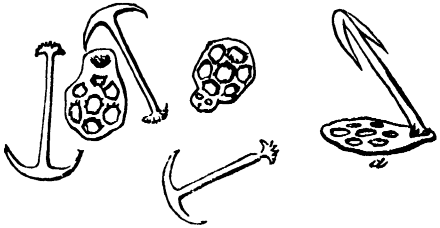


FIG. 6.—Synapta.

Rouge." Their form in this tribe is most singular, a perfect anchor of glass without the "stock." Though usually separated from the perforated plates by the process of preparation for the microscope, in the living animal they are hinged together as shown at *a*, in such manner, apparently, as to allow of some movement. The "flukes" of the anchor stand above the surface of the skin, and, probably, assist in the progression of the animal, which is destitute of the ambulacra, or sucking-feet, possessed by the *Holothuriæ*. Messrs. Smith and Beck are now furnishing slides of the skin of *Synapta inhærens*, showing the spicules *in situ*; in this species they are slightly less elegant and smaller than those in the figure, which represents the spicules of *S. vittata* magnified sixty diameters.

A species nearly allied to the last, and also a native of the south, the *Chirodota violacea*, is furnished with spicules as singular as those of the *Synapta*, though of very different form; they closely resemble a wheel, as represented in Fig. 7, the spokes varying from four to six, the whole being very thin, and the inner edge of the hoop minutely toothed. There is a British species, but it is not yet known if it possesses these remark-

* See "Evenings at the Microscope," p. 358.

able plates. Many marine animals, besides those named, are known to be furnished with these calcareous bodies, mostly radiata of

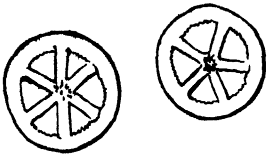


FIG. 7—Chirodota violacea.

the zoophyte or echinoderm sections, but they also occur in the pretty Doris, one of the mollusca, and it is probable that many new and curious forms would be brought to light if those who meet with the foreign species of these groups would bring them home, or even pieces of the skin dried, and place them in the hands of microscopists for examination.

In contemplating these delicate objects, as in a thousand other instances, one can scarcely fail to be struck with the amount of beauty and ornament which the Creator has thus buried, as it were, out of our sight, and which would never have been known, but for the instruments which man has contrived in the later stages of his civilization.

GEORGE GUYON.

OZONE.

IT has been a matter of popular observation, for some centuries now, that when a powerful flash of lightning is discharged near to an observer, a peculiar smell is experienced, somewhat pungent in character, and resembling no other smell with which popular observers are at all acquainted. Some of these sagacious people have declared that they distinctly perceived the smell of sulphur, or, to use their own language, brimstone.

There has ever existed, however, and, in later times, in increasing numbers, a reflecting, questioning, hesitating, class of men—men of a metaphysical turn of mind—who refuse to place too much reliance on the evidence of the senses; and these, after well considering the phenomena in question, and the general character of the witnesses, came to the conclusion that the fancied smell was mere fancy without the smell. It was so very easy, they averred, to connect the *blue* tint of the lurid lightning with the appearance of burning sulphur, and then imagine they could actually smell it.

At length the phenomenon presented itself under a different shape. It was found that when a series of electric sparks was sent through a vessel containing pure oxygen, a peculiar smell was also experienced. And that when water was electrolyzed, that is, decomposed by voltaic agency, the same smell was perceived about the pole which attracted the oxygen to itself.

It does not appear to be well established, whether or not any one who has made himself familiar with the experiments just named, has also had an opportunity of comparing the generated odour with that supposed to accompany the lightning flash. Moreover, flashes of lightning are not exactly the sort of article that one likes to be brought into too close proximity with, so that it is probable there will ever be some doubt about the identity of the two odours, if, indeed, that of the lightning really exists.

Be this as it may, the opinions of respectable folks, like those who make experiments with electrical machines, and resolve water into its constituent gases, are not to be trifled with, even by beings so august as metaphysicians; and these latter have decided, I believe, with their characteristic wisdom and good taste, that the electrical experimenters are quite capable of forming a judgment on the subject for themselves, and that if they form a wrong one they are sure to find it out sooner or later, and substitute for it a better.

Now let us collate the observations and experiments of some of those philosophers who have paid particular attention to this subject. Among these philosophers, M. Schönbein, of Bâle (indifferently written Basle or Basil), has pre-eminently distinguished himself. Professor Faraday, of the Royal Institution, and Dr. Andrews, of Belfast, have done much to throw light on the question; as have also MM. Frémay, Becquerel, and Baumert, in France.

Of course the first thing to ascertain was the cause of the odour—that is to say, whether it was the result of some change effected in the elements acted upon by the electric fluid, or to the liberation of some new substance with which chemists hitherto had been unacquainted. Most of the investigators above named came to the conclusion that the odour resulted from a curious change in the oxygen, by which it was completely altered in its nature and properties, while it continued, notwithstanding, to be oxygen still, and oxygen only. Similar transmutations of other elements were already familiar to chemists. Thus, the element sulphur may assume, besides the yellow crystalline form in which it is so well known, the consistency, flexibility, and colour of darkened India-rubber. The element phosphorus is well known in the form of a whitish, crystalline, soft, and pliable mass, having a strong smell and taste, deadly poisonous, and bursting into flame at a temperature scarcely exceeding that of the human body, but it can be made to assume the form of a dark red, amorphous, hard, and brittle mass, without smell or taste, and, as far as we know, devoid of poisonous qualities, while no heat or friction has hitherto kindled it, for at the temperature of 600° it is reconverted into its original condition of ordinary phosphorus. Further, the element carbon is well known to every one in the widely dissimilar forms of common charcoal, plumbago (black-lead), and the diamond.

This demonstrated existence of the same body in another form is called *allotropism*, and the substance under this new aspect is said to be *allotropic*. Thus, the oxygen acted upon and altered in its properties by the electric spark may be denominated allotropic oxygen. The name, however, is found inconveniently long, and hence M. Schönbein gave it another, derived from one of its most notable qualities—its strong and peculiar odour. He called it OZONE, from the Greek ὄζω, I smell.

Still it would not be wise to conclude too hastily that ozone has always this constitution; for Baumert, after paying considerable attention to the subject, came to the conclusion that it was a compound body, consisting of three equivalents of hydrogen with one of oxygen (OH_3), and hence denominated a teroxide of hydrogen. Some chemists of eminence, after examining the evidence which each brought to bear in support of his theory, supposed that there must be *two* ozones, exactly or nearly similar in their reactions, but differing in composition. But Dr. Andrews, on repeating Baumert's experiments with the utmost caution, came to the conclusion that, even in this case also, the observed reactions were due to allotropic oxygen, and not to any compound whatever of that element with hydrogen. With this doubtful point we shall not concern ourselves further. If any reader of RECREATIVE SCIENCE has time and means at his disposal, and has a desire to distinguish himself by an investigation of the problem, he will acquire a tolerably clear idea of the point to which former experimenters have conducted it by reference to the "Philosophical Transactions," part i., 1856; for June, 1857; and

January, 1859. He may acquire further information by reference to Erdmann's "Journal für Praktische Chemie," vol. l., p. 259; vol. lii., pp. 135, 183; vol. liii., pp. 51, 65, 321, 501; vol. liv., p. 65. It will be sufficient to note here that the ozone of which we speak is, or is generally supposed to be, that which consists of allotropic oxygen, and that only.

There are many ways of preparing this curious substance, but, before explaining them, we must have at hand a test-paper, by means of which we may judge of the presence or absence of ozone, when we have reason to suspect either the one or the other. Schönbein's test is a very delicate one, and is thus prepared:—Take

Iodide of potassium	.	1 part.
White starch	.	10 parts.
Distilled water	.	200 parts.

Boil them together in a flask about a minute, not longer, and, when cold, saturate slips of white blotting-paper with the solution. When dry, or containing only hygrometric moisture, they are ready for use. In applying these papers for the purpose of testing, they should be placed in the atmosphere supposed to contain ozone, and left there for several minutes if the presence of ozone is doubtful; but if it be suspected that ozone exists in considerable quantity, a few seconds' exposure of the test-paper to an atmosphere containing it will be sufficient. On withdrawing the paper, moisten it with water, when it will become more or less deeply blue, according as ozone exists in greater or less abundance, or according to the time the paper has been exposed to its action. Supposing we have a supply of these tests now at hand, we may proceed with our explanation of the methods by which ozone is generated.

The best is, to send a series of electric sparks through a tube containing pure oxygen. But this is a difficult and inconvenient method, and is never had recourse to except in those cases where absolute purity is desired. A more ready way is to take a glass vessel with a good wide mouth (Fig. 1),

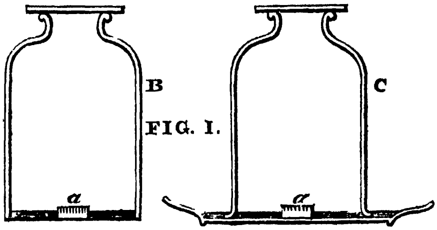


FIG. I.

and cover the bottom with distilled water. Then take one of your test-papers, and hold in the bottle for a minute or so; moisten it, and observe that no change has yet taken place, and the test is quite unaffected. Now take a short stick of phosphorus, and scrape it clean in order to remove the coat of oxide which always gathers round that substance whenever it is exposed to the air; throw it into the jar as at *a* (Fig. 1), and see that it is only about half covered with the water. As soon as the dry portion of the phosphorus becomes luminous, and phosphorescent fumes rise towards the top of the jar, it may be presumed that ozone is in process of formation, and will in about a minute be ready for the test.

While the process is going on, let us add a precaution or two. In order to facilitate the action of the phosphorus on the atmosphere, the jar and surrounding air should be kept as near as may be at a temperature of 60°. If the temperature be higher than this the phosphorus might inflame; indeed, at this temperature such an issue is not impossible, and should therefore be also provided against by covering the mouth of the jar with a loose cap, so that no harm might arise from the spattering of the ignited phosphorus, which would certainly attend its combustion in contact with water.

Let us now remove the cover from the jar, and hold a slip of the test-paper in the ozonized atmosphere. Remove it after a few seconds, moisten it, and see if any change of colour results. If not, let the paper remain a longer time, say an hour, and try again. Unless some of the foregoing precautions have been neglected, it is scarcely likely to fail; but if it should, the cause of failure may be sought for (1) in the temperature of the room; (2), in the imperfect scraping or subsequent reoxidation of the phosphorus; (3), in the impurity of the iodide of potassium, of which the test-paper was made; or (4), in the impurity of the water used.

Before detailing other experiments, we will describe a second easy way of generating ozone; the experimenter may then use which he likes in his future recreations. Take the jar B (Fig. 1), insert a slip of test-paper, and observe that no change takes place; indicating that no ozone is present. Throw into the jar a small quantity of ether; test again, still no change. Agitate the vessel slightly, so as to fill it with vapour; test again; no ozone will now, most probably, be immediately indicated by the test. If not, or if the traces are very faint, make the rod a little hotter than the hand can bear, and immerse it again. It is not likely that any difficulty will be experienced now in obtaining evidence of the presence of ozone. But should there be, the difficulty must be met by trying the rod at a somewhat lower or higher temperature. Experience alone will guide the experimenter in this matter. Suffice it to say, that *if the rod be cold*, no ozone will be generated, and that *if it be too hot*, any ozone that may be generated will be immediately destroyed, *i.e.*, reconverted into common oxygen.

In fact, this latter phenomenon affords a demonstrative proof of the identity of ozone with oxygen. For if pure ozone be passed through a red-hot glass tube, it comes out at the end in the form of ordinary oxygen, and that purely.

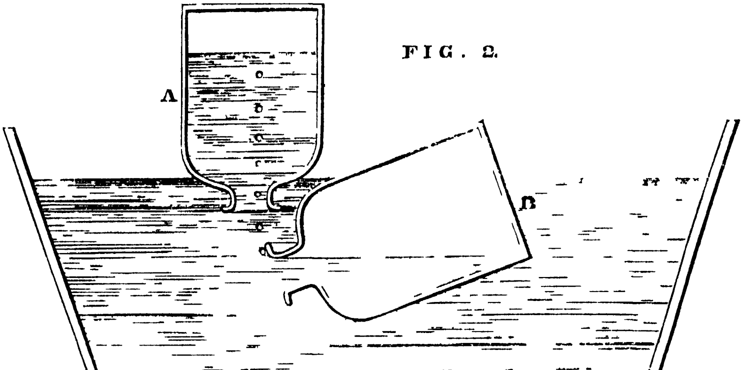


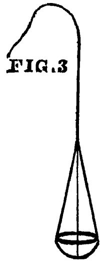
FIG. 2.

race of ozone even yet. Now take a glass rod, about a quarter of an inch in diameter; heat it in the flame of a spirit-lamp (or gas-lamp, if you take care to remove the deposit of soot that collects upon it) till it becomes as hot as the hand will bear without inconvenience. Immerse it in the ether vapour, and hold it there a few seconds; traces of

Either of the methods above described will yield ozone in sufficient abundance, and of sufficient purity, for the experiments which follow. The experiments selected are those which require no expensive or complicated apparatus; all others being rejected as unsuitable to our present purpose.

Exp. 1.—Fill a jar (A, Fig. 2) with water, cover the mouth with a piece of cardboard, invert it, and place it in the trough so that the mouth shall fall a little below the surface of the water. Fill another jar (B, Fig. 2) with a thoroughly ozonized atmosphere, one that has been some five or six hours in process of formation, by means of phosphorus, invert it, plunge it mouth downwards into the water, bring it carefully under the mouth of the jar A, and gradually turn its mouth upward so as to decant the air from B into A. By this means, any phosphorous acid that might be floating in the jar, and which might interfere with our experiments, will be completely dissolved by the water, and the ozonized atmosphere in the jar A will be sufficiently pure.

Exp. 2.—Into a small glass or porcelain capsule (Fig. 3) place a little water, coloured with solution of sulphate of indigo. Let it down gently into the jar prepared by Exp. 1, and observe that the solution loses its colour; in fact, is bleached. Here we perceive an analogy between ozone and chlorine. Ordinary oxygen produces no such effect.



When it is remembered that bleaching used to be performed by exposing fabrics alternately to the action of water and that of sun and air, it may be worth an inquiry whether the result was not due to the action of ozone formed naturally in the atmosphere, which we shall presently see is a common occurrence.

Exp. 3.—Prepare another jar of ozonized air. It will not be necessary to transfer this water, having in the former experiment satisfied ourselves that the observed reaction is due to the ozone and not to the vapours of phosphorous acid. Now, take a piece of putrid meat, or any other decaying animal substance, immerse it in the jar, and let it remain for a minute, or longer, if found necessary; on removing it, it will be found to be completely deodorized. Here again we perceive an analogy between ozone and chlorine; for the disinfecting and deodorizing powers of chlorine are well known and frequently employed.

It should be noticed that when the piece of meat is dry, and consequently covered with a sort of cuticle, the action of the ozonized air is not readily manifest. Hence, it is desirable that the putrid substance should be well moistened before immersion in the jar.

Exp. 4.—Into a jar of ozonized air suspend a thread, or thin slip of India-rubber. After a few minutes it may be withdrawn, when it will be seen that the ozone has so affected it as to render it rotten, and deprive it of its characteristic tenacity. This is a remarkable result; since India-rubber is used for many purposes in the laboratory, on account of the resistance it offers to the action of most acids, alkalies, and gases. But ozone acts upon it with such violence that it cannot be used in any of those experiments in which the two are liable to come into contact. Dr. Andrews asserts ("Phil. Trans." part i. 1856, p. 3), that India-rubber is attacked with such violence by ozone, that even when diluted with 1000 times its weight of other gases, a tube of this material is perforated by it in a few minutes.

Exp. 5.—Put a slip of silver-leaf into a similar jar, taking care that ozone exists in tolerable abundance. The silver will be speedily attacked by the gas, and changed into oxide of silver—a powdery, crumbling, substance, without any of the lustre and tenacity of the metal.

As we have just spoken of an "abundance" of the gas, we may here stop to observe that we by no means intend to convey the idea that the jar is to be full, or nearly full of it. Even when pure oxygen is acted upon by either the electric spark or phosphorus, a comparatively small portion of the gas is converted into ozone. It is obvious, therefore, that when atmospheric air (containing four-fifths of nitrogen) is ozonized, a still smaller proportion can be expected to be formed. A consideration of this fact is necessary to prevent our expecting too much in the way of reaction in any given experiment.

Exp. 6.—Test a jar of ozonized air, and assure yourself of the presence of ozone in the usual way. Let down into the jar an open capsule (Fig. 3) containing peroxide of manganese, and let it remain for a short time. Test again; and all trace of ozone will have vanished. The ozone will have been converted into ordinary oxygen. This is an illustration of that curious phenomenon called *catalysis*, a term applied to that influence which certain bodies exert upon chemical changes by their mere presence, without entering into combination, or suffering in themselves any change whatever.

If any of the foregoing experiments be attempted with pure oxygen, or with ordinary atmospheric air, the result will contrast forcibly with those above indicated.

Let a mouse or any small animal be placed in an ozonized atmosphere, it speedily dies. This might be expected, since, if a small quantity of such air be inhaled, its irritating. chlorine-like qualities will immediately be manifest. From this it may be inferred that its presence in the atmosphere in too great quantity would prove injurious to health.

On this question philosophers have speculated largely, and have arrived at widely different, though perfectly consistent conclusions. Dr. Wolf, of Berne, thinks that its presence is a cause of disease. Others have decided that its presence in moderate abundance is an essential condition of health. We must, however, reserve our consideration of this question for a future opportunity. It will be sufficient to observe here that ozone is formed in some localities naturally, and under certain circumstances abundantly; so that before any safe conclusions can be formed respecting its influence, observations and experiments must be extended and multiplied. And here lies the importance of the subject to those who find recreation in meteorological pursuits. Let the character of ozone be understood, an interest in its operations awakened, and a ready means of determining its absence or presence be devised, and we might hope to have observers in every part of the kingdom, who would offer contributions to our meteorological statistics, without which we are in danger of forming hasty generalizations and jumping at conclusions which subsequent investigations may compel us to revise or even abjure.

R. Bithell.

OUR OLD NEIGHBOUR THE SPARROW.

The house-sparrow enjoys a pretty extensive popularity, for he forces himself into notice by his comical audacity; and he enjoys also a notoriety by no means enviable, by his bold exercise of a will of his own in his association with man—not because he loves him, but for what he can get. If the sparrow is brought into court as an impudent thief, I am ready, brief in hand, to act as counsel in his defence, and very hard I shall plead to save him from having his neck twisted. He's an old neighbour—I have known him from childhood—never did harm to me or anybody else—always did his best to make music in the housetop gutter—asked for no arbitrator when engaged in a quarrel, as he very often has been, and always fought it out with clamorous iteration of the motto, "May the best beak win." The prisoner at the bar certainly did draw a few ears of wheat from the prosecutor's rick, but they were his fair wages for work done months before; and the custom of prisoner's community is to act in their own right, and help themselves to their proper dues. He comes of an ancient family; and though much has been said against him and his ancestors, he is not to be condemned on *ex parte* libellous aspersions; and if the question of character is to be raised at all, I must trouble the court with a sketch of his history.

In the great republic of birds, the sparrow holds a decidedly respectable place. Of the genus *Passer*, he is the *Passer domesticus* of Aldrovandus and Wildenow, Ray and Selby, As a member of the great family of Finches, he is better known as the *Fringilla domestica* of Linnæus, Pennant, Montagu, and Yarrell, the last of whom has said less about him than he ought to have done. Cuvier and Fleming describe him as *Pyrgita domestica;* and he has a few other classical names in good books that are almost forgotten. As a *sparrow* he claims kindred with all that's old and hearty in the rural life of England; for the Saxons, who gave our out-door lares such pretty names as merle and mavis, knew our neighbour as the *sparwa,* a word which came to them from older etymologies, and which simply signifies a bird of active habits, a bustling busy-body, one who delights in making a feathery fuss. The modern form of the word has been long in use. Wickliffe translates the well-known passage, St. Matthew x. 29, "Whethir two sparrowis (*twegen spearwan,* A. S.) ben not sold for an halfpeny, and oon of hem schal not falle on the erthe withoute your Fadir." So, in another version, of 1551, "Are not two sparowes solde for a farthyng? And none of them doth lyght on the grounde withoute your Father." The use of the sparrow in illustration of our heavenly Father's care for *us,* in that sweetest of the Saviour's homilies, derives its chief point and force from the fact of the sparrow's close association with man, as one of the commonest of common creatures. To sever the connection utterly, you must hie to some stony and unpeopled desert; there you will find no sparrows; but if you erect one solitary hut in the waste, they will find you out, and share your company along with the tufts of grass that are sure to take root at your doorstep. Nature has provided three humble companions for her paragon, man, and they are the tuft of grass, the groundsel, and the sparrow; and wherever man tills the soil, and makes himself a home, these will be the tenants of his threshold. Nowhere is the sparrow more plentifully distributed than in these islands; and it extends its range beyond them to Orkney and Shetland, to Denmark, Norway, and Sweden, thence, southwards, it ranges over Germany, France, Spain, Portugal, and Northern Africa; in the south-east, over Italy, Corfu, Dalmatia, and the Ionian Islands, and Yarrell adds Trebizond, the Nubian Mountains, the Himalaya, Nepaul, Calcutta, and the Deccan, as places of its residence far away, in every one of which it insists on enjoying human society, and desires to be esteemed a friend as well as a neighbour. How is it then that his history has never been written? How could Yarrell content himself by dismissing him in a mere page or two? and why did Neville Wood, Esq., try his pen upon him, only to abuse him? He has beauty; but you must see him in the bright holiday attire he wears in the fresh air of the country, for in towns his garments are always sooty, through his habit of burrowing in deep holes under grimy tiles and slates, and the rarity of his ablutions. The London sparrows seldom wash; but, as if rejoicing in the murk that surrounds them, prefer a good dusting in a garden-path, or a highroad; and as the roofs and tree-tops where their social meetings take place are begrimed with smoke, their uniform assumes the character of spoilt sable —neither a good black nor any other colour.

The length of the house-sparrow is six

inches. The females are fuller-bodied, and generally more bulky than the males; and during the breeding season the males are sleek and sprightly, and very easily distinguished from their rather sedate partners. The top of the head and cheeks are bluish ash-coloured, the rest of the upper parts chesnut brown, with blackish centres; some of the smaller wing-coverts are tipped with white; the rump is pale brown; tail dark brown with pale edges; there is a faint stripe behind the eye, along the chin, and the throat; in the male black, in the female blackish brown. The under parts are dull grayish drab. In a town-sparrow these colours are so muddled by the intermixture of soot, as to be distinguished with difficulty. In the country sparrow they are definite and striking, and entitle the male birds, at least, to favourable consideration for their beauty.

The sparrow is a sociable bird, and invariably forms communities, large or small, according to the accommodations of the neighbourhood. When they select a place of residence, it is not merely that one pair may build and rear their young, but that a sparrow colony may be established. This tendency to colonize influences at least one peculiarity of the bird's instinct in a modifying manner. It never builds in trees if it can find suitable resting-places about roofs and walls; but where those are not attainable, trees and bushes are selected sooner than the habitations of man or the cattle-steading shall be sparrowless. It is at the season when pairing takes place that our neighbour shows his pugnacious individuality, and his tremendous love of gossip. It is a time of general excitement, and of very earnest, though unsuccessful, attempts at song. Neville Wood abuses the sparrows as destroyers of the peace that belongs to the twilight by "their barbarous jumble, all chirping together, and each apparently endeavouring to outdo the other, in their unceremonious gabblings." I must openly confess, though it may be to my discredit in the matter of taste, that I can heartily enjoy the morning and evening chirpings of a great colony of sparrows, even in places where those same meditative hours are enlivened with the notes of the blackbird, the thrush, the nightingale, and other true songsters of the grove, as they are in my little garden at Newington, where the sparrows are not particularly numerous. When living near London years ago, the sparrow was my only free bird of song, and it was a frequent source of amusement to distinguish the several notes, as they expressed the varying emotions of love, hatred, social gratulation, and open war, of a large colony that had undisturbed possession of a vast sheet of ancient ivy which covered the garden side of the house. Just before dusk the intermixture of a thousand voices all uttering the same note, made a chorus that was certainly acceptable and soothing in its way, and preferable to dead silence, because it was at least "a touch of nature," in a region where nature had more enemies than friends. The cheerful clamour of the morning was a very different affair. The day would break, as the night closed, with a general song of thanksgiving, performed by a company, ranged in a line along the roof of the house; and when that was ended, there would be all sorts of utterances, many of them unmistakable in their meaning. The quick succession of clear hurried notes running into each other—an honourable though failing attempt at a song—was the expression of that tender feeling to which the gallants of a sparrow community are eminently subject, and for which they play the part of chivalric knights, whenever an opportunity presents itself for a display of courage. This love-song is quite distinct from the ordinary note of the sparrow, which is certainly entitled to the undignified appellation of a "yelp," as first given it by Wilson, adopted by Rennie, and repeated by every author who has written on sparrows subsequently. Chaucer, in the Sompnoure's Tale, v. 7384, makes a lively point for a comparison out of the peculiar note of the sparrow:—

> "This frere ariseth up full curtisly,
> And hire embraceth in his armes narwe,
> And kisseth hire swete, and *chirketh* as a sparwe."

The love-call is certainly more of a chirk than a yelp, but it needs long and frequent observation to determine the varieties of sparrow language, as expressive of passion, alarm, or domestic felicity. In a little while hence, the sparrows will begin their courtship; then listen for the loud "chirk, chirk," and you may discover that it proceeds from the throat of a lusty cock in the full beauty of his wooing dress; the black on his head having the richness and depth of velvet, and his whole action as sleek and sprightly as becomes a gallant lover, rejoicing over the sober dame who is presently to become his bride. But, alas! the course of true love does not always run smooth. She may have cast a favourable glance upon another, or a bold rival may give the challenge to fight for the maiden's hand. Then the chirk ceases; a sharper note, more quickly repeated, and accompanied with fearful jerkings of the head and tail, impetuous hoppings from side to side, and a general displacement of those lately well-preened feathers, pronounce the quick approach of war. These love-battles are generally conducted on the principles of true chivalry. The rivals have it all to themselves; the conflict is short, sharp, and sanguinary, and the victor claims the subject of it for his bride. The war-note is sounded by both parties throughout the fight, until the moment of conquest arrives, when the defeated gallant gets out of the way as quickly as his buffeted wings will carry him, and the champion returns to his chirking ten times louder than before. "None but the brave deserve the fair."

Scarcely a day passes, where the colony is of any extent, without one or more of these sanguinary conflicts; but as the season progresses, and all the swains have won their wives, there is no fair excuse for their continuance. And here I must admit, to the damage of my client's character, that he prefers to make excuses for mischief, rather than live in the prosaic enjoyment of continual peace. Not that green-eyed jealousy ever shows its face in a sparrow's home. No! the connubial tie is never broken by infidelity; no duels arise because of faithless spouses or truant lords. For the sake of the favour with which every description of heroism, however romantic, is received, I could almost wish it were so; but I must confess with sorrow that all the subsequent disturbances are not for love, nor for principle, nor for political triumph, but for meat! The song which Leigh Hunt gives to the fairies might, leaving out the suggestion of "stolen kisses," be just as well given to our neighbours for their own national melody:—

> 'Stolen sweets are always sweeter;
> Stolen kisses much completer;
> Stolen looks are nice in chapels;
> Stolen, stolen be your apples:
> Truth the fruit were scarce worth peeling,
> Were it not for stealing, stealing."

I must own that my client prefers ill-gotten to honest gain. When the liberal cook has strewn the yard with the débris of the bread-basket, and the pavement is spread like a groaning board with enough for all, there is sure to be more fighting than feeding; and the possessor of a pellet of bread will be pursued by an inveterate army of savage beaks and claws, all of which might have been better employed in helping themselves to the general bounty. But how different are these turmoils to the displays of true chivalry in early spring. Then the brave combatants met to utter mutual defiance, and fight it out. The battle was a test of bravery and power. Now it is a contemptible row, and nothing more; and Paddy's prescription for the enjoyment of Donnybrook is carried out to the full—"Wherever you see a head, hit it." What a confusion of angry voices. What a yelping from the thick of the elder-tree, the slope of the thatch, or the remote corner of the yard, where, as if by magic, half the company at least have got together in a scrimmage, and each separate sparrow is engaged without meaning in fighting all the rest. Political economy is evidently not a leading subject of study in the university of sparrows. But who would not forget all this when nightfall comes again, and the evening song is repeated from every roof of the village, and from some two or three of the largest trees upon the green? It ought to give enjoyment even to the most critical of musical ears, for it is the expression of content. A better judge of what is true in Nature, and harmonious with man's sense of happiness, than most of those who traduce the sparrow, John Clare, associated it with the best of the enjoyments of the early season of the year:—

"Sweet are the omens of approaching spring,
When gay the elder sprouts her winged leaves;
When tootling robins carol-welcomes sing,
And sparrows chelp glad tidings from the eaves.'

Though married, the happy pair are not soon settled. The building of the nest is an affair of considerable fuss and bustle, though the result scarcely justifies even one chirp of congratulation. A deep hole in an old wall, a very dark recess far back under the roofing-tiles, or a sheltered and snug nook in a gable or warm thatch, is the sort of place in which the happy couple prefer to huddle together a lot of rubbish, and dignify it with the name of nest. I used, years ago, to make a survey of all the nests in the ivy on the great breadth of wall where my own colony of sparrows had their metropolis; and now I have many nests brought to me every season by a man who is engaged in repairing the roofs of houses, and whose instructions are never to disturb one unless his work compels him, and instead of throwing it down, to bring it intact to me. Not a word can I say of my client as a genius in construction; and as to architecture, he is ignorant of its rudest elements.

True, there is this distinction about the sparrow's nest, it is invariably domed when in any way exposed to the weather, and the entrance is on one side; but when in a snug recess, a few feathers and some gatherings of hay, hair, and moss are thrust in almost anyhow, and the couple settle down contentedly, in accordance with the Vicar's starting apothegm, that "to bring up a family is the first and highest privilege of a citizen." Authors who say that the house-sparrow prefers to build in trees, make a statement which is simply untrue. There is no room for doubt or speculation in the matter. The sparrow never builds in a bush or tree, if it can find a suitable place in or about some kind of building. It is, in fact, a tender bird, susceptible of cold, and frequently roosts in winter in the holes where nidification took place in spring, and during sharp frosts sparrows will often busy themselves in gathering feathers to re-line those holes, in order that they may enjoy warmth at night. I can almost imagine that Cowper's charming poem of "Pairing-time Anticipated," though the sparrow is not one of its characters, was suggested by the poet's observation of sparrows gathering nest materials during the bitter frosts of February, and his connecting the fact with a supposed intention on their part to pair at once, instead of merely intending to make themselves warm berths during their single blessedness.

A strange thing is a sparrow's nest. Some that I have pulled to pieces contained quite as many scraps of rag, threads of Berlin wool, wisps of silk and cotton, as of hay and feathers. I once lost a memorandum written on a narrow slip of parchment, which blew out of my study window, on a bright spring morning, and though searched for soon after among the shrubs in the garden, could not be found. Two years afterwards, a sparrow's nest fell with a sad crash out of the colonised ivy on to the top of a cistern in the kitchen yard. It contained three eggs, nearly hatched, and two naked and helpless chicks of a few hours' old, which were killed by the fall. In removing the dead chicks and half-crushed eggs, what should I discover but my long-lost parchment memorandum, worked into the side of the nest, along with a curling lock of somebody's auburn hair, and a scrap of flimsy paper, impressed with the poetry and typography of the immortal Catnach. Some time ago, a correspondent sent me an account of a huge sparrow's nest that was taken from the fork of an apple-tree at Styrrup, near Sheffield, in which three ladies' collars, that had been missed from the adjoining hedge a few weeks previous, were cleverly worked in, and ruinously smeared and discoloured. But feathers are their favourite material, and among the recollections of my London colony in the old ivy-wall, is one that I often call to mind with amusement. I had then living with me a lively young nephew, who took great interest in the sparrows, because there were several nests within reach of the hand from the window of his bedroom. This boy had been an early riser, but, for a time, he seemed to have given up his good habits, in imitation of the sluggard. Looking up one morning at the bustle going on in the ivy, what should prove a new incident in the life of the sparrows but the appearance, successively, of a single white feather, darted, as it were, from the supposed sluggard's window, which feather had not proceeded far on its projected course, than out darted a sparrow from the ivy to seize it in his beak as it flew forward, and return to the ivy to add the treasure to his nest. A chuckle of delight from that same window was too distinct and suggestive to pass unnoticed, and on quietly breaking in upon the author of the joyous chuckle, he was discovered quietly inserting his fingers into a hole which he had cut in his bed-tick, in order to pull out the feathers to puff them out of window for the sparrows. It was mighty good fun, no doubt, for him, and no one could see the successive flights of feathers and the darting of the sparrows to capture them, without being interested; but it was brought to an end by the interdiction that followed, and the resumption by the culprit of the excellent habit of coming down as well as rising early. In my sketch of the sparrow in "Brambles and Bay Leaves," several instances of remarkable sparrow-nests are cited.

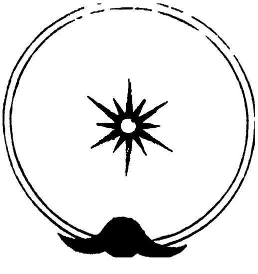
Owing to the partiality of the sparrow for bits of thread and woollen rag, he sometimes gets entangled in the fastenings of his own tent, and it is not uncommon for fierce struggles to take place under the tiles, where some unlucky cock or hen has got entrapped. He partly deserves this for the careless way in which he builds his walls, but he scarcely deserves to be hanged in his own noose when pursuing his calling industriously. Such fatal catastrophes happen, however, and not a few sparrows fall victims to their propensity for woollen goods. Rennie relates an instance of a pair of sparrows which had carried off a long piece of bass; but when this had been successfully stowed in the nest, it appeared they had not sufficient skill to work it into the fabric, and both birds got their feet inextricably entangled in the folds, and were held close prisoners. Around them assembled their cackling neighbours, who appeared to be occupied in scolding them for their folly, instead of imitating the mouse that released the lion—in assisting them to get rid of their entanglements. They were taken down and freed from their fetters, but were too exhausted to survive their struggles, and a pair of their scolding neighbours took possession of their premises a few days after. A note in the first volume of the "Zoological Journal" states that a pair of sparrows, which had built in a house at Poole, were observed to continue their regular visit to the nest long after the time when the young birds take flight. This unusual circumstance continued throughout the year, and in the winter a gentleman, who had all along observed them, determined on investigating its cause. He mounted a ladder, and found one detained a prisoner by means of a piece of string or worsted, which formed part of the nest, having become accidentally twisted round the leg. Being thus incapacitated from procuring its own sustenance, it had been fed by the willing and watchful parents. A still more tragical occurrence is related in the "London News" of January 20, 1844. A sparrow had built its nest in the eye-socket of the carved head of an ox, which formed part of a frieze of one of the buildings in Sackville Street, Dublin. By some means he had got his neck into a noose, and in struggling to get free had fallen out of the nest, suspended by the neck, like a wretched criminal, from the eye-socket of a skull.

SHIRLEY HIBBERD.

REMARKABLE MOCK-SUN AND SOLAR HALO,

SEEN AT THE BEESTON OBSERVATORY.

ON September 24th, at 11 A.M., for fifteen minutes there was a mock-sun, with bended rays, resembling a bird flying *upside down*,



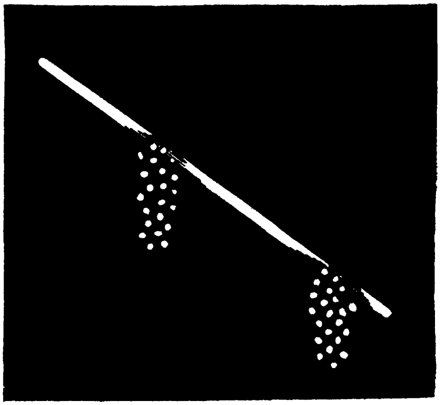
and situated at the base of a halo of 22° 30′ radius. From 11h. 0m. till 11h. 4m. it was very brilliant. The day was fine. On the previous day there had been solar and lunar halos. At 2 A.M., on the 25th, heavy rain set in, which continued till 10h. 30m. A.M., with wind.

E. J. LOWE.

REMARKABLE METEOR

SEEN AT HIGHFIELD HOUSE OBSERVATORY.

ON the 1st of November, at 8h. 30m. P.M., a remarkable meteor, equal to the apparent size of Jupiter, moved from S. to W. It started from below γ Pegasi, and moved downwards at about an angle of 42° with the horizon. When about η Aquarii it paused, burst, and threw down, perpendicularly, a number of detached fire-balls, similar in ap-



pearance to those discharged from a rocket. It moved forwards, and when near ϵ Aquarii it burst a second time, discharged a similar number of fire-balls, darted forward 3°, then suddenly vanished. The colour of the meteor was yellow; the fragments red, blue, and yellow; its duration was three seconds; a streak of light was left in the track; the pauses in motion were very apparent.

E. J. LOWE.

that is left standing of that ancient city, is an arch about fifty feet high. One of the guides told Mr. Kater that on the key-stone of the arch was still to be seen one of the effigies of the city, "the Sirena Pœstana," holding a rose, but nearly effaced by time and weather. It was with difficulty that any thing of this could be seen; but Mr. Kater photographed it, and the effigy became well developed, more particularly by means of a magnifier. There is no doubt that in this way many interesting archæological *morceaux* may be taken and preserved. C. M. Archer.

METEOROLOGY OF DECEMBER.

FROM OBSERVATIONS AT HIGHFIELD HOUSE OBSERVATORY.

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Year.	Mean Temperature of the Air. Degrees	Mean Temperature of the Dew Point. Degrees.	Mean Pressure of the Air. Inches.	Mean Amount of Cloud. (0—10).	Number of Rainy Days.
1846	32·5	31·0	29·666	5·4	20
1847	43·6	40·1	29·663	8·9	19
1848	42·5	38·7	29·793	6·9	21
1849	36·8	34·3	29·817	7·0	23
1850	38·6	36·4	29·858	6·9	15
1851	40·1	37·4	30·111	8·2	12
1852	44·6	40·5	29·515	7·5	26
1853	34·4	29·8	29·821	8·1	14
1854	40·7	36·4	29·677	6·5	20
1855	35·8	32·0	29·702	6·6	12
1856	39·1	35·5	29·571	7·3	18
1857	44·4	40·9	30·071	8·1	13
1858	39·6	35·7	29·708	8·4	16
1859	34·0	28·8	29·596	6·5	11
Mean	39·0	35·5	29·753	7·3	17½

The mean temperature of the last fourteen years for December is 39·0, the range in the mean temperature being from 32·5° in 1846 to 44·6° in 1852—a difference of 12·1°. The lowest means occurred in 1846, 1853, and 1859; and the highest in 1847, 1852, and 1857.

The mean temperature of the dew-point of the last fourteen years for December is 35·5°, the range being from 28·8° in 1859 to 40·9° in 1857—a difference of 12·1°; the lowest means occurring in 1846, 1853, 1855, and 1859; and the highest in 1847, 1852, and 1857. The temperature of the dew-point was in 1859 as much as 5·2° below that of the temperature of the air, whilst in 1846 it was only 1·5°; the mean difference being 3·5°.

The mean pressure of the last fourteen years, for December, is 29·753 inches at the height of 174 feet above the mean sea-level, ranging between 29·515 inches in 1852, and 30·111 inches in 1851—a difference of 0·596 of an inch (or six-tenths of an inch). To reduce these readings to the sea-level, it is necessary to add 0·193 of an inch, when the mean temperature is as low as 32·5°, and 0·188 of an inch when it is as high as 44·6°, as in 1852. On applying this correction, the mean pressure, reduced to the sea-level for December for the past fourteen years, is 29·943 inches.

The mean amount of cloud for December for the past fourteen years is 7·3 (or three-fourths of the sky covered with cloud). The amount ranging between 5·4 as in 1846, and 8·9 as in 1847—a difference of 3·5, a difference of a third of the whole sky.

The mean number of rainy days in the last fourteen years for December is 17½, ranging between 11 in 1859 and 26 in 1852—a difference of 15 days. The years of but little rain are 1851, 1855, 1857, and 1859, and of much rain, 1848, 1849, and 1852.

E. J. Lowe.

ASTRONOMICAL OBSERVATIONS FOR DECEMBER, 1860.

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The Sun is in the constellation of Sagittarius until the 21st, when he passes into Capricornus. He approaches nearest to the earth on the 31st at 2h 41m. a.m. He rises in London on the 1st at 7h. 46m., on 11th at 7h. 58m., on 21st at 8h. 6m., and on 31st at 8h. 8m., and sets in London on the 1st at 3h. 52m., on 8th at 3h. 49m., on 17th at 3h. 49m, on 18th at 3h. 50m., on 21st at 3h. 51m., and on 31st at 3h. 59m

The time the Sun is above the horizon in London is on the 1st, 8h. 6m., on the 13th 7h 49m., on the 17th only 7h. 45m. (shortest period), and on the 31st 7h. 51m.

The Sun rises in Edinburgh on the 1st at 8h. 9m., on the 9th at 8h. 21m., on the 14th at 8h. 29m., and on the 22nd at 8h. 33m.; and sets on the 2nd at 3h 28m., on the 10th at 3h. 23m., on the 15th at 3h 22m., and on the 23rd at 3h. 25m.

The Sun rises in Dublin on the 3rd at 7h 58m, on the 23rd at 8h. 18m.; and sets on the 5th at 3h 39m., and on the 24th at 3h. 42m.

Day breaks in London on the 1st at 5h. 41m., on the 9th at 5h. 51m., on the 11th at 5h. 54m, on the 19th at 5h. 59m, and on the 29th at 6h. 1m.

Twilight ends in London on the 10th at 5h. 55m., on the 15th at 5h. 55m., on the 22nd at 5h. 58m., and on the 30th at 6h. 0m.

The Sun reaches the meridian on the 1st at 11h. 49m. 25s.; on the 11th at 11h. 53m. 42s.; on the 21st at 11h. 58m. 35s.; on the 23rd at 11h. 59m. 35s.; on the 24th at 12h. 0m. 5s.; and on the 31st at 12h. 3m. 30s.

The Equation of Time on the 1st is 0h. 10m. 35s.; on the 11th, 0h. 6m. 18s.; on the 21st, 0h. 1m. 25s.;

on the 23rd, 0h. 0m. 25s. before the Sun, or subtractive; on the 24th, 0h. 0m. 5s.; and on the 31st, 0h. 8m. 30s. after the Sun, or addition.

New Moon on the 12th at 12h. 47m. p.m.

The Moon is full on the 28th at 3h. 17m. a.m.

The Moon is at her greatest distance from the Earth on the 20th, and at her least distance on the 8th.

Mercury is in the constellation of Scorpio at the commencement of the month, and in that of Ophiuchus at the close. He reaches his greatest westerly elongation on the 16th, and is then favourably situated for observation in the morning. He rises on the 2nd at 6h. 43m. a.m., on the 17th at 6h 4m. a.m., on the 27th at 6h. 37m. a m ; and sets on the 2nd at 3h. 37m. p.m., on the 17th at 2h. 48m., and on the 27th at 2h. 41m. p m. Diameter of the planet, on the 1st 9″, on the 25th, 5″.

Venus is in Virgo at the beginning of the month, passing through Libra to that of Scorpio at the end of the month. A conspicuous object, and a morning star. Rising on the 2nd at 4h. 9m. a.m., on the 17th at 4h. 53m. a.m., and on the 27th at 5h. 22m. a.m.; setting on the 2nd at 2h. 29m. p.m , on the 17th at 2h. 9m. p.m., and on the 27th at 2h. 2m. p.m. Diameter of the planet on the 1st, 11″; on the 25th, 12½″.

Mars at the commencement of the month is in Aquarius, at the end he is in Pisces. He rises on the 2nd at 12h. 39m. p.m., on the 17th at 11h. 56m. a.m., and on the 27th at 11h. 25m a m ; setting on the 2nd at 11h. 5m. p.m., on the 17th at 11h. 4m. p m., and on the 27th at 11h. 5m. p.m. Diameter on the 1st, 8″ ; on the 25th, 7″.

Jupiter is in Leo, and a very brilliant object. His diameter on the 1st is 37″; and on the 25th, 39½″. He rises on the 2nd at 9h. 56m. p.m., on the 17th at 8h. 57m. p.m , and on the 27th at 8h. 16m. p.m.; setting on the 2nd at 12h. 56m. p.m., on the 17th at 11h. 27m. a.m., and on the 27th at 10h. 48m. a.m.

Saturn is also in Leo, and a good object. Rising on the 2nd at 11h. 3m p.m , on the 17th at 10h. 6m. p.m., and on the 27th at 9h. 25m. p.m.; setting on the 2nd at 12h. 55m. p.m., on the 17th at 11h. 56m. a.m., and on the 27th at 11h. 17m. a.m.

Uranus is in the constellation Taurus, and very favourably situated for observation. He is in opposition with the Sun on the 1st. Rising on the 2nd at 3h 39m. p.m., on the 17th at 2h. 39m. p.m., and on the 27th at 1h. 58m. p.m.; setting on the 2nd at 7h. 55m. a m., on the 17th at 6h. 53m. a.m , and on the 27th at 6h. 13m. a.m.

Eclipses of Jupiter's Satellites.—On the 2nd, at 12h. 55m. 42s. a.m., 4th moon reappears. On the 2nd, at 1h. 15m. 4s. a.m., 1st moon disappears. On the 9th, at 3h. 8m. 6s. a.m., 1st moon disappears. On the 15th, at 11h. 42m. 19s. p.m., the 3rd moon reappears. On the 17th, at 11h. 29m. 26s. p.m., 1st moon disappears. On the 23rd, at 12h. 6m. 21s. a.m., 3rd moon disappears. On the 23rd, at 3h. 40m. 4s. a.m., 3rd moon reappears. On the 24th, at 11h. 4m. 35s p.m., 2nd moon disappears. On the 25th, at 1h. 22m. 32s. a.m., 1st moon disappears. On the 30th, at 4h. 4m. 42s. a.m., 3rd moon disappears.

Occultations of Stars by the Moon :—On the 24th, No. 23 Tauri (5th magnitude) disappears at 4h. 41m. a.m. On the 28th, δ Geminorum (3½ magnitude) disappears at 7h. 38m. p.m., and reappears at 7h. 48m. p.m.

The variable star Algol reaches its minimum amount of light in the evening on the 17th at 11h. 50m. p.m., and on the 20th at 8h. 39m. p.m.

Stars on the Meridian:—On the 1st, ε Tauri souths at 11h. 36m. 22s. p.m. On the 2nd, α Arietis souths at 9h. 11m. 40s. p.m. On the 2nd, Aldebaran souths at 11h. 39m. 53s. p.m. On the 3rd, Capella souths at 12h. 14m. 20s. p.m. On the 10th, α Andromidæ souths at 6h. 42m. 23s. p.m. On the 14th, α Orionis souths at 12h. 16m. 6s. a.m. On the 15th, Rigel souths at 11h. 28m. 31s. p.m. On the 17th, α Arietis souths at 8h. 12m. 42s. p.m. On the 17th, Aldebaran souths at 10h. 40m. 54s. p.m. On the 19th, α Ceti souths at 9h. 0m. 21s. p.m. On the 20th, α Orionis souths at 11h. 48m. 35s. p.m. On the 27th, α Arietis souths at 7h. 33m. 22s. p.m. On the 27th, Aldebaran souths at 10h. 1m. 35s. p.m. On the 31st, α Arietis souths at 7h. 17m. 39s. p.m.

Highfield House Observatory. E. J. Lowe.

THE MICROSCOPIC OBSERVER. DECEMBER.

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Lichens.—Coincident with the mosses, the lichens have their highest season of development during the winter months, when their stains of brown, gray, ochreous yellow, red, and green, are recorded on the boles of trees, on old walls, on tiled roofs, and on weather-worn gateways. Though often roughly-classed with the mosses, by persons unaccustomed to scientific observation, they are too obviously distinct in their general external appearances, as well as in their physiological structure, to give rise at any time to questions of their identity, even if there be a doubt as to their special place in the class of *Thallogens* to which they belong. They are very properly placed between the *Algæ* and the *Fungi*, and they are distinct from both, though some authors class them with the latter, because some forms of Fungi pass, by almost insensible gradations, into the characters of the Lichens. The thallus of a lichen is very different from the thallus of an alga; the reproductive organs are distinct enough to entitle them to separate classification, and as they are strictly aerial in growth, and draw their whole nourishment from the air, they are easily recognized as such by the most casual observer. The majority are foliaceous, though this character passes on one hand into a sort of crusty lamination, and on the other into the form of rugged bristly patches. Most of them have their own special kind of nidus, such as the surface of stones, bark of trees, or sandy earth, but some are parasitic on living leaves, and on other lichens. The fructification consists of sporules generally, with a pore at the summit;

sometimes of shield shaped bodies, scattered over the surface of the fronds, or borne at the summits of the branches of the bristly kinds. The fructification is in a few the only part commonly visible, the fronds being microscopic and concealed. The fronds adhere with considerable tenacity, by the inferior surfaces, to the substances on which they grow by means of microscopic filaments, which contain cells filled with chlorophyll, and these filaments are capable of reproducing their kinds by means of gonidia, when the fronds and proper fruits are separated from them. *Parmelia parietina*, which produces lively patches of yellow on old walls, is a pretty example of the crustacean growth of lichens, and of the development of the thallus in foliaceous lobes. The thallus of this species exhibits four distinct kinds of substance, the upper or cortical layer containing the coloured cells, the under layer of white cells, the gonidia and the medullary filaments, which are interlaced, and from the upper part of which the gonidia arise. The pseudo roots by which the plant adheres arise from the lower cortical layer. The respective values of the true fruits and the gonidia depend materially on the circumstances of the plant. Sometimes excess of moisture prevents the development of the normal fructification, in which case the gonidia enlarge and break through the cortical layer, and spread like a mealy powder over the thallus. Owing to this occasional abnormal reproduction, some species have been founded in error, the intermediate form being taken for the typical, which would appear subsequently if the observation were continued. The true fruits are the *thecæ*, or sacs, which contain the spores, and which are probably fertilized by the spermogonia or antheridia, which are minute bodies borne on short stalks. *Borrera ciliaris*, common on branches of trees, and of which we met with some fine examples on stumps of sloe beside the river-path leading from Tilbury to Grays, lately, affords a pretty example of cup-shaped *Apothecia*.[1] *Spherophoron coralloides*—one of the prettiest of the arborescent lichens—has closed globular apothecia, which open at the summit to discharge the spores. The thecæ are generally elongated cells, with thick walls, and the spores have various characteristics, which form the basis of the classification of species, but are generally oval or globular bodies containing granular matter. A pretty experiment on the fructification of lichens is thus described at p. 421 of the "Micrographic Dictionary:"—"If a portion of the thallus, moistened, is placed in a common phial, with the apothecia turned toward one side, in about eight or ten hours the surface of the glass opposite each apothecium will be found covered with patches of spores, easily perceptible by their colour, these having been projected from the apothecia with force. If placed on a moist surface, and a slip of glass laid over them, the latter will become covered with them in the same way, and Julasse states that they are projected to a distance of more than half an inch from the theciferous layer, the spores being emitted continuously for a long time. The experiment may be tried either in winter or summer, and has been made with success on several common species of Parmelia, Lecanosa, Peltigera, Collema, Borrera ciliaris, Verrucasia, Murallis, Endocarpon, Hepaticum, Pertrisaria, Neceolaria, Opegrapha, etc. The usual number of spores in a theca is eight, but there are many exceptions, both of more and less. The spermogonia are quite distinct, as reproductive organs, from the theca. They appear as black or brown points near the margins of the thallus, and are hollow pustules or conceptacles, sometimes divided into chambers containing spermatophores, on which are borne the spermatia, to be in due time discharged from the spermogonia. These are analogous to antheridia, and, doubtless, perform the office of rendering the spores fertile.

Fireside Studies.—The student in want of subjects would do well, some odd evening, when out-door observations are suspended by the weather, to turn out his drawers of lepidoptera, and all odd boxes and places where insect captures have been deposited during summer, whether mounted, or preserved for mounting. When specimens have been arranged, and faulty ones have been replaced by good examples, the bits of legs, wings, etc., will furnish capital subjects for the microscope. One insect leg will, perhaps, be sufficient for the study of an evening, and the characteristics of its five parts should be observed with sufficient accuracy for the determination of its genera, if not of its species. The microscopist should aim at carrying into practice, amongst his own peculiar subjects, the determination of species from a single organ, as Cuvier and Professor Owen have done in their enlarged application of the details of structure in Zoology. The Christmas goose and turkey will afford examples of feathers for general and special comparisons, and examples of many kinds may be prepared. A few grapes, hung in a damp corner, will produce *Botrytis*; *Mucor mucedo* may be obtained from mouldy bread, and *Penicillium glaucum* may be obtained from a pot of jam which has been placed for a week in a warm cupboard. The exposure of a damp glass-slide in a warm greenhouse for a day will generally produce examples of the same fungus in a peculiar form, as sometimes known by the name of cholera fungus.

Objects worth Seeking.—The December moth and yellow-line quaker moth, *Colymbetes fuliginosus*, *Carabus morbillosus*, the drab day moth, and the flat-bodied moth, may be met with this month. *Bissocladium* occurs on windows. *Lepralia*, a genus of infundibulate polyzoa, are pretty common now on stones and shells at the sea-side. *Nidularia* occur on dead sticks and neglected dung-heaps, *N. campanulata* being most common. *Tremella* on dead wood and crevices of the bark of trees, *Verrucaria*, a genus of angiocarpus lichens, are most common on ash-trees; the apothecia are rounded, and are closed by a special perithecium. *Bembidium poccilum* and *Bembidium properceus*, *Opilus mollis*, *Phosphuga atrata*, and *Scaphidium quatuor maculatum*, *Spilocæ pomi*, one of the *Coniomycetous* fungi, frequently on apples when removed from the fruit-room, and before being wiped for the table. The *Targonia* section of *Hepaticæ* abundant in wet places; *Glaucous Riccia* on rocks; *Graphis stricta* on bark.

Mr. Noteworthy's Corner.

NATURALISTS' FIELD CLUB.—Recreative Science has its votaries in commercial circles, as well as amongst the learned of the land. In Liverpool there is a "Naturalists' Field Club," which, although it has only been in existence about six months, already numbers above 250 members. The principles upon which the society was established, as embodied in its rules, are, that it should "encourage the practical study of Natural History in all its branches;" and in order that all classes may avail themselves of its advantages, the annual subscription has been fixed at five shillings, and the admission to membership has been rendered as easily accessible as is consistent with the maintenance of respectability and the comfort of members already enrolled. The management of the society is intrusted, as usual, to a committee, to be elected annually by ballot, and it is proposed that at each annual meeting the president shall present to the club a summary of its proceedings. Honorary members, being persons distinguished by their attainments in Natural History, or who have rendered valuable services to the club, are also to be elected, and these will enjoy all the privileges of ordinary members. The most interesting feature, however (and one that we blush to record as somewhat unusual in scientific societies), is the admission of ladies to all the privileges of membership. Nay, we are glad to say that the gallant naturalists of Liverpool are employing their best efforts especially to promote the happiness and cultivate the intellects of the fair companions of their excursions. This, as well as the mode in which the operations of the society are conducted, will be the best appreciated by the perusal of the following card of invitation, which is the pattern of those issued to the members previous to each excursion:—"Liverpool Naturalists' Field Club.—In order to take advantage of a peculiarly favourable ebb tide, the third Field Meeting will be held at Hilbre Island, on Saturday, July the 21st, 1860. A steamer will leave the North Landing Stage at two o'clock p.m. Fare, there and back, 2*s*. Tickets are required, and procurable at Mr. Walker's, 20, Ranelagh Street. As there will be Dredging on the Passage, wide-necked bottles will be useful. Addresses will be delivered by Dr. Collingwood on the Zoology, Mr. H. Duckworth on the Geology, and Dr. Nevins on the Botany of the Island. A Ladies' Botanical Prize will be offered. WILLIAM BANISTER, Hon. Sec., St. James's Mount." A "Ladies' Prize" is offered at each Excursion, and at present it consists of one of "Lovell Reeve's" scientific series. There can be no doubt that the establishment of such societies as this will do more to further the interests of science than any other means that could be suggested. Fresh air, healthful exercise, and happy social intercourse rendered more agreeable by the discarding of all feelings of caste and the cultivation of the highest intellectual powers in tuition, or in the acquirement of knowledge, all here combine to render man what he should be—a happy, reflecting being, who enjoys to the fullest extent the works of Nature, and participates in the contemplation of them with Him who sees that they are "very good."—S.

FLYING FOXES.—Mr. Noteworthy, being ever on the alert for things curious and uncommon, was highly gratified a few days since to meet with a set of six flying foxes, in the most beautiful condition, at No. 191, Piccadilly, where they may be inspected by any one who will pay the sum of a shilling for admission. They have been brought from India by an intelligent, and perhaps too enterprising, Frenchman, who tends them with the utmost care, and has so far succeeded in taming them, that they come out of their cage and explore his face and shoulders with their beautiful eyes, sensitive noses, and formidable claws, all the while fanning their great black wings, punka-fashion, in his face. London has thousands of little exhibitions of this kind, extemporized for the display of monstrosities, curiosities, and impositions, of which Mr. Noteworthy has had endless experiences. But this is an opportunity for naturalists to make acquaintance with a rare and beautiful creature, which has seldom reached these shores alive, and in the whole range of animated nature is nowhere surpassed for uniqueness of construction and adaptive beauty.

AUSTRALIAN ARCHÆOLOGY.—On reading the article by the Rev. H. Eley on Maori Customs, my recollection reverted to a period some few years ago, and to a spot in the interior of Australia, from which the native fauna were commencing a retreat from the presence of the intrusive herds of the white man. The faces of the new lords of the soil were strangers to the aboriginal denizen, who had as yet adopted none of the customs or tastes of the new comers. It was on this occasion I visited a native encampment. The native lords of the creation were mostly engaged in shaping out their rude weapons of war and of the chase. Two of the more gentle sex were whiling away the heavy hours in the absorbing occupation of scratch-cradle. Feeling assured that such an amusement had not been engrafted on their native customs by the whites, the circumstances engaged my attention and reflection at the time as exceedingly curious, but I do not remember having since seen any notice of it elsewhere. The manipulation, I quite remember, was different from my own childish recollections of a game which has amused most of us when younger. I think, then, that this fact, in connection with a similar fact in New Zealand, is worthy of notice; for it is certainly remarkable to reflect that the amusements of children, with us the *dolce far niente* of that far distant boudoir where fashion's reign owns no sway, should be similar. I can hardly be induced to think that the idea of the game originated spontaneously from the native mind like their own bomerang.—J. E. K.

Fig 1.—Nepenthes Phyllamphora.

PITCHER-PLANTS.

The simplest weed which grows is worthy of our deep and serious study. The vegetable gems which nestle by hundreds on our sunny hedge-banks, the poor little blade of grass struggling for existence between the paving-stones of the street, the tuft of moss that finds abundant nourishment upon the roof of our house—not one of them but would furnish us with materials for an hour's thought. We pass them by, too often, little heeding their wondrous structure or the lessons they could teach. But there be other plants which, from their singular forms, or from their rarity, arrest our attention at the first glance. Of this we have no better example than the pitcher-plant. No person ever sees this plant for the first time without being struck by its curious structure. Like all other strange and rare natural objects, these have been made the subject of fabulous traditions; they have been endowed with properties and functions which do not exist. Only the other day I took up a book designed to furnish young readers with descriptions of many curious natural productions. In it the pitcher-plant was, of course, mentioned, and it was described as furnishing a [illegible] of pure water to the poor traveller [illegible]ith thir[illegible] the desert, and fainting "b[illegible] a h[illegible]er sky." It was said, too, that the pitchers open their lids to catch the scanty dew, and close them again to prevent evaporation, before the first rays of the morning sun rest upon them. Nothing could be more false or more unlike the truth. To dissipate error is a duty we should never leave unperformed; and, in a sketch like this, we look upon it as even a greater duty than the publication of original observations, or of facts which shall be really new.

The pitcher-plants are natives of the East Indies, growing in hot and fever-haunted swamps, where rank and luxuriant vegetation overshadows them, and rooting amid the decaying remains of primæval forests. Borneo would seem to be their headquarters; in that island twelve or fourteen species have been found, on the Indian peninsula four, in Java and Sumatra four or five each, in Madagascar two, in China and the Philippine Islands one. The Kasia Hills appear to be the northern limit of the family, *Nepenthes Phyllamphora* (Fig. 1) being found there at an elevation of about 3000 feet. Many species are found in two or more of the localities above mentioned, and the numbers given show only that they abound most in Borneo, and decrease in number as we recede from that centre. There are probably in all about eighteen or twenty species, or well-marked varieties.

These pitcher-plants form a very distinct group, all closely related to each other, but having no very great affinities with other plants. They are woody-stemmed climbers (the wood abounding in spiral vessels and well adapted for examination under the microscope), and they have alternate leaves, which clasp the stem; these leaves are usually prolonged into pitcher-shaped appendages at the apex. According to scientific phraseology, the part which looks most like a leaf is but the expanded and foliaceous petiole (or leaf-stalk). be the correct explanation, but it appears more natural to me to look upon the pitcher as a special appendage to the leaf. The pitchers are quite closed while young; but, when fully developed, the lid stands open, and does not close again during sunshine, or at any other time. These pitchers are sometimes wanting on the strong vigorous shoots; in this case the leaf terminates in a kind of tendril, by which the plant attaches itself to the shrubs over which it may be climbing. One very curious circumstance about these plants is, that the very first leaves produced (after the cotyledons or seed-leaves) by the young seedling plants are furnished with little pitchers. I had an opportunity of observing some, lately, in the celebrated nursery of Messrs. Low and Son, at Clapton, and very interesting it was to see them in this stage of growth, when the whole plant might be covered with a fourpenny piece. The inner surface of the pitcher is furnished with glands which secrete the water which usually half fills it.* This water is said to "emit, while boiling, an odour like that of baked apples, and, if evaporated to dryness, to yield minute crystals of superoxalate of potash."

It is not so easy to determine what the purpose of these pitchers may be. I have an idea that they may be traps for catching insects, which, by their decomposition, should furnish nourishment for the plant. Knight, the great horticulturist, says he found that *Dionæa muscipula*, whose leaves are furnished

* This great power of secretion is not without its parallel. *Colocasia antiquorum*, a large East Indian swamp plant, allied to the *Arum* of our hedge-banks, and having shield-shaped leaves three feet or more in length, shows this well. If examined during the evening, after a sunny summer-day, water will be seen to drip from the point of the leaf; this is not the atmospheric moisture condensed upon its surface, but water secreted or distilled by the plant itself. It is quite pure and tasteless. Under favourable circumstances the drops follow each other as fast as they can be counted. *Richardia* (or *Calla*) *Ethiopica*, a plant often used for indoor decoration, possesses the same peculiarity, but in a less degree, and needing the most favourable circumstances to exhibit it.

with unmistakable traps (whence its common name "Venus's fly-trap"), was benefitted and grew more vigorously after placing little pieces of raw beef in the "traps." Our little English "sun-dews" (species of *Drosera*) catch insects by dozens; and, if what Knight says be true, may not the same end be attained in these plants by the decay of insects they have themselves entrapped. One can seldom examine the pitchers of a Nepenthes without finding many small insects drowned therein; and I have often seen the tubular part of the *Sarracenia* leaf (Fig. 3) half-filled with dead ants, flies, bees, and wasps, and the leaves seemed in perfect health, although the insects were in a state of rapid decomposition. I am the more inclined to take this view of the matter, because I find that either by some odour, or other means, insects are decoyed into these pitchers and easily enter them, but there are means in all these plants which make egress difficult, and, in most cases, impossible. Thus, in the *Sarracenias* (to be mentioned presently) the inner surface of the tubular leaf, or pitcher, is closely covered with short, stiff hairs, all pointing downwards. These—acting on the principle of the old-fashioned wire mouse-trap, or the wicker-baskets used for catching lobsters—allow the insect to push forward into the tube, but close upon him behind, and make retreat impossible. In the *Nepenthes*, the same end is attained by the mouth of the pitcher being turned sharply towards the interior.

FIG 2.—A, Nepenthes Lowii, B, Nepenthes Rajah, C, Nepenthes distillatoria, D, Nepenthes ampullaria.

I have often heard the pitchers of these plants spoken of as their flowers. So gross an error scarcely needs refuting, as no person, possessed of the slightest botanical knowledge, would be so easily deceived. They are seldom seen in bloom in this country, and when they are, their flowers are by no means showy. They are produced in long drooping spikes; the sexes separated—that is, on one spike we find only stamen-bearing flowers, on another merely the pistils. The male flowers have a number of anthers borne at the top of a short thick column; the females, a square fruit composed of four cells, and producing a large number of seeds. These seeds are very small, and furnished with a thread-like appendage at each end, which Dr. Lindley supposes may be "intended to act at first as a buoy, to float the seed upon the surface of the water, and afterwards to keep it anchored on the mud until it can have struck root."

Macbongbruh or *Priska* is the Malay nam for the pitchers of the *Nepenthes*. I am told the name may be interpreted "monkey-cup,"—a very appropriate term. Figs. 1 and 2 will give an idea of some of the varied forms which these *ascidia*, or pitchers, assume. Fig. 1 represents a shoot and pitcher of *N. Phyllamphora*, the latter is about half the natural size. This species is found in Borneo, China, and the Indian peninsula; it is the one most frequently found in our English hothouses. Fig. 2, A, is the pitcher of *N. Lowii*, named in honour of Hugh Low, Esq., who discovered it on Kina Balou, a Bornean mountain. Fig. 2, B, is that of *N. Rajah*, which was also found by Mr. Low on the north coast of Borneo. It is the largest yet known. Specimens of both these new and remarkable plants were placed by their discoverer in the Museum of the Royal Gardens, Kew. Fig. 2, C, is *N. distillatoria*, a native of China and Ceylon; this was the first species known, and was cultivated in England as long ago as the close of the last century; it is now, however, more rarely seen than some

FIG 3.—A, Leaf of Sarracenia flava, B, Leaf of Sarracenia purpurea; C, Leaf of Darlingtonia Californica.

others. Fig. 2, D, is *N. ampullaria*, which grows in the swamps of Sumatra, Malacca, and the Philippine Islands. In this species the pitchers cluster thickly together on the surface of the soil; they are very small, and probably would not hold more than a tea-spoonful of water, while that of *N. Rajah* would hold more than a quart.

While the true pitcher-plants (*Nepenthes*) are confined within the limits we have above defined, there are in the swamps of the southern part of the United States a set of plants which are indeed wholly different from them in many essential particulars, but still resembling them in having hollow pitcher-like leaves, closed while in a young state by a lid, as in *Nepenthes*. These are the already-mentioned "side-saddle" plants (*Sarracenia*). They are entirely distinct from *Nepenthes* in their floral organs, and resemble them only in the functions of their leaves. About six species are known, two of which are shown in Fig. 3, where A is a leaf of *Sarracenia flava*, and B of *S. purpurea*. A nearly-allied plant, *Heliamphora nutans*, is found growing in similar situations in Guiana. Another plant, with the apex of the leaf curved over, and the lid developed into two ear-like processes, has lately been introduced to our gardens from California, under the name of *Darlingtonia Californica* (Fig. 3, C).

At the south-west corner of Australia, in the swamps about the neighbourhood of King George's Sound, we find yet another curious little plant, wholly distinct from either of the families above-mentioned, but still, like them,

FIG. 4.—Cephalotus follicularis.

producing pitchers. It is called *Cephalotus follicularis* (Fig. 4). Its pitchers are not attached to the leaves as in the other instances, but developed separately. It is a stemless plant, and nestles down among the wet moss so as to be almost hidden. In its floral organs this plant is nearly allied to the butter-cups (*Ranunculus*) of our meadows.

C. W. CROCKER.

Royal Gardens, Kew.

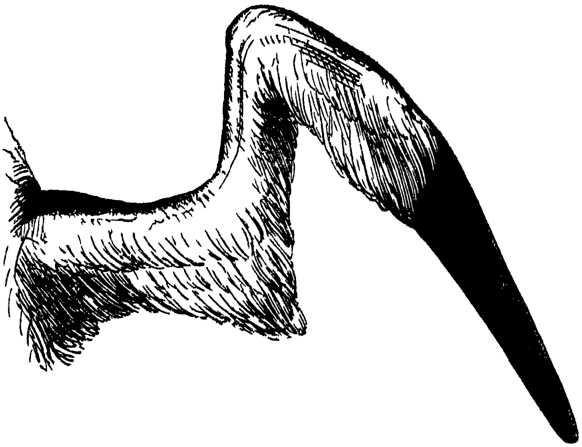
PADDLE-WINGED BIRDS.

THERE are many terrestrial birds whose wings are so rudimentary as to be utterly useless as organs of flight. At a not very remote period, the number of such brevipennate birds was far greater than in the present day; in fact, we can enumerate more extinct species, the semi-fossilized bones of which are attestations of their having existed until very recently, than are now to be found through Africa, the Indian Islands, Australia, New Zealand, and South America. The dodo, the solitaire, the great Madagascar ostrich, and the moas have perished, and the residuum consists of one ostrich, two cassowaries, two rheas, one emeu, and two, perhaps three, species of kiwi, to which may be added the notornis, or flightless gallinule of New Zealand, which is extremely rare, if not now altogether erased from the list of extant species.

It is not, however, to terrestrial brevipennate birds that we apply the term "*paddle-winged.*" We appropriate it exclusively to aquatic birds; and this indiscriminately without respect to the order or genus to which they individually belong; for, be it observed, they do not form a family group. In this point of view they remind us of apterous insects, once all huddled together in a single order (now effaced from every entomological system), but which in reality belong to very different groups, and these wide apart from each other. Of such orders they are exceptional examples.

As among terrestrial brevipennate birds we trace out a scale of development or of degradation in the wings, which, at best, are but rudimentary, so among these aquatic birds do we meet with great variations; but in none is the wing useless, as in the emeu or kiwi, and, moreover, the less it is adapted for flight, the more efficient is it as an oar or paddle.

Many aquatic birds have vast powers of flight, but then their wings are not used as paddles. It is true that the ocean supplies them with food, and that they both skim its surface and plunge beneath the waves; many, indeed, settle to rest on the water, lifted up and let down by the heaving and sinking billows. These are not true swimmers; yet from them commences a graduated scale of descent, though the word is not truly and justly applicable till we arrive at the oceanic penguins, utterly flightless—heavy, and submerged on their own element, but as much at home in it as is the porpoise or the seal—apodous and brachipodous mammals.



Under View of long, narrow Wing of the Albatross. (Half expanded.)

It is interesting to trace out the gradations of wing-development in aquatic birds.

Let us glance for a moment at the circling gulls, whose light and gracefully sweeping movements no one can have witnessed without admiration. Let us consider the albatross, which exults in the gale, and stems the fury of the tempest. Then come its tiny relatives the petrels, which, in the trough of the rolling billows, sheltered from the wind, and half-tripping the water as they fly, follow in the wake of the vessel for many a league. Look, again, at the tropic birds (*Phæton*), cleaving the air with the velocity of an arrow; birds which seek the desolate land only for the purpose of incubation. We must not forget the terns (*Sterna*), *hirondelles de mer*, which skim the waves of the sea as does the swallow the rippled surface of the lake or pool. Nor can we pass by the frigate birds (*Tachypetes*), oceanic falcons or vultures, which, sailing in the heavens, far, far away from land, plunge from their aerial altitude, and snatch their prey from the foaming surface of the deep. These, to use Cuvier's expression, are "*grands voiliers*"—mighty sailors; but they sail through cloud-billows and the drifting storm.

Let us descend from these birds of high flight, whose very bones are part of their lungs, to a lower step in the ladder. The cormorants present themselves. These fish-eating, strong-winged divers pursue, otter-like, their prey beneath the water. In China they are trained to fishing, and such was the case in England up to the close of the reign of James II., and even later—the hawk and the falcon for the air, the cormorant for the water.

Scarcely oceanic in their habits—for they affect the broad embouchure of rivers, and narrow straits, creeks, and "fiords." These birds come inland as evening closes, and roost upon rocks or even trees. In the morning they return to their fishing stations, and, after repletion, habitually take their siesta on jutting masses of stone, or on uncovered sand-banks, where, semisomnolent, they sit motionless, in an erect, or nearly erect, attitude, supported materially by the stiff, elastic feathers of the tail. Their wings are short, with rigid quill-feathers, and their flight, though somewhat heavy, is strong, but direct. As swimmers and divers they are admirable. They swim with the body submerged, or nearly so, and use their wings as oars, and their tail as a horizontal rudder, for assistance in diving and rising. They pursue their prey entirely below the water, giving regular chase, and following their quarry by the eye, greyhound-like, with marvellous celerity.

As another pertinent example, we may cite the darters, or snake birds (*Plotus*), of which one species is African, another American. These birds are remarkable for the length and slenderness of the neck, which, as they swim with the body completely submerged, is elevated above the surface in a snake-like attitude. The darters roost and nidify upon trees, and, during flight, the long neck is said to be stretched out in a line with the body. When at rest among the foliage, the oscillation and tortuous movements of the neck, the body being hidden, remind the observer of the actions of tree-snakes. These birds use their wings both as organs of aerial and aquatic progression, and their ample, stiff tail as a sub-aquatic elevator or depressor. We may also refer to the grebes. In these aquatic birds the legs are placed so far back as to give no stability to the body upon land, where they shuffle along on the breast, pushing with their feet. Their wings are short, stiff, and act as subaquatic oars, in conjunction with the feet, and they swim and dive with wonderful address. Indeed, when pursued and hard pressed, they attempt to escape only by diving, and this they do so instantaneously as sometimes to avoid the shot from a well-aimed fowling-piece. Mr. Selby observes that, while under water, their progress is performed by an action of the wings somewhat similar to that of flying, and is so speedy as frequently to baffle the pursuit of a well-managed boat. A stretch of 200 yards is sometimes made before the birds raise the beak above the water for the purpose of respiration. Yet these birds, difficult as they find it, from their shortness of wing and want of tail, to rise into the air, are most of them migratory in their habits, and when, not without exertion, they have attained to a considerable altitude, they pursue their aerial course with great velocity.

The same observations apply to the divers

(*Colymbus*), which rise with difficulty from the surface of the water, but which, when once fairly in the air, fly with great velocity. The subaquatic progression of the black-throated diver has been calculated to be (while escaping from pursuit) at little under the rate of eight miles in the hour.

If we pass from these to the guillemot, the razor-bill, and the puffin, we shall observe a great diminution in powers of flight, of which indeed during the moulting season they are utterly incapable, living at that time entirely out at sea. At the best, from the shortness of their pointed wings, and the apparent absence of a tail, they rise with difficulty, and their flight is limited to short distances. They breed upon the ledges of rocks, and are constantly bringing food for their young from the sea. In order to rise, they skim along the surface of the water at a rapid rate, by means of quickly-repeated strokes of the pinions, and then rising a little, make a circuitous flight, in order to attain to an elevation sufficient for them to reach their breeding ledge. From this ledge they plunge into the sea like a shot, and give chase to young herrings, sprats, and other fishes. These birds migrate, on the approach of winter, to warmer latitudes, especially to the Mediterranean, along the coasts of Italy and Cicily, where they feed abundantly on the anchovy and sardine. These migratory journeys are chiefly, perhaps, performed by short flights upon the wing, but in part also by aquatic travelling, instinct directing them in their course.

These birds lead us at once to aquatic birds utterly incapable of flight, the wings of which are used exclusively as oars. The step from the razor-bill to its relative the great auk (*Alca impennis*) is immediate.

In the great auk, a native of the high northern latitudes, the wings are so abbreviated as to be useless as organs of aerial progression, but as fins or oars they compensate for the deficiency. The great auk is essentially aquatic; its whole existence, except during the period of incubation, is passed on or in the sea. Its swiftness under water, and the length of time during which it will remain submerged before it rises for breath, are almost incredible. To a certain extent the great auk is migratory; it breeds on the coasts of Norway and Iceland, but is still more abundant, or rather was so, around the shores of Greenland and Spitzbergen. It lays, like the razor-bill, only a single large egg, blotched and marbled; its site of incubation being some dark recess among precipitous cliffs just above the reach of the highest tides. The migration of this noble bird never extends further southward than the north of Scotland, and indeed its appearance there is only occasional; but from whatever point it arrives, the intervening distance has been traversed by swimming only. Although the wings of the great auk are powerless in the air, still the quill-feathers, the secondaries, etc., are all normal as to position and number, but singularly short, rigid, and scale-like. There is reason to fear that this bird is on the eve of extinction. We may now advert to a group of birds in which we cannot find such distinction of wing-feathers. We allude to the penguins.

Wing of Great Auk. (Inside view; the feathers distinct, but useless for flight)

The penguins (*Sheniscidæ*) may be said to represent in the Southern Seas the great auk of the Northern Ocean, but they constitute a totally separate family. On land the penguins assume an upright attitude, resting on the whole of the short stout tarsus, which is applied foot-like to the ground. This attitude, so apparently constrained, results from the extreme backward position of the legs. Thus erect they walk, or rather waddle along, the legs alternately crossing each other at every step, and the body swaying from side to side as each step is taken. The wings are true paddles, covered with short, rigid, scale-like feathers, disposed in close and regular order, there being no indication of quill-feathers, secondaries, etc. In some species these wings are used, at least occasionally, as fore-limbs during progression on land. The general plumage is close, glossy, and impenetrable by water. It reminds us of the coating of the seal; and, in fact, the penguin among birds appears to be the analogue of that animal among mammalia. The skin of these paddle-furnished birds is tough and oily, and the bones are hard, heavy, and compact; those of the limbs are destitute of air-cavities, but contain an oily marrow. The penguins are all natives of the temperate or colder latitudes of the Southern Seas, and the species are rather numerous.

Scale-feathered Wing of Great Penguin. (A perfect paddle-wing)

Awkward as these birds are on shore, where they may be seen assembled together in vast multitudes, they display the greatest address in their congenial element. They swim and dive with ease and rapidity, and even leap, as if in playful sport, quite out of the water. One species displays this habit to such an extent that it has obtained the French name of *gorfou sauteur*. It is the *Endyptes chrysocoma* of Vieillot, and its range is extensive; it inhabits the shores of Patagonia, the Falkland Islands, the island of Tristan d'Acunha, the shores of Van Diemen's Land, etc. The jackass penguin (*Spheniscus demersa*) also leaps, fish-like, out of the water, and on land moves on four limbs like a quadruped. The range of this species also is very extensive. Mr. Darwin, who met with this bird at the Falkland Islands, gives the following account of its habits:—"One day, having placed myself between a penguin and the water, I was much amused with watching it. It was a brave bird, and, till reaching the sea, it regularly fought and drove me backwards. Nothing less than heavy blows would have stopped him, every inch gained he firmly kept, and stood close before me, erect and determined. When thus opposed, he continually rolled his head from side to side in a very odd manner, as if the power of distinct vision lay only in the anterior and basal part of each eye. This bird is commonly called the jackass penguin, from its habit while on shore of throwing its head backwards, and making a loud strange noise, very like the braying of that animal; but while at sea and undisturbed, its note is very deep and solemn, and is often heard in the night-time. In diving its little plumeless wings are used as fins, but on the land as front-legs. When crawling, it may be said, on four legs, through the tussocks, or on the side of a grassy cliff, it moved so very quickly that it might have been mistaken for a quadruped. When fishing, it comes to the surface for the purpose of breathing with such a spring, and dives again so instantaneously, that I defy any one at first sight to be sure that it is not a fish leaping for sport."

In the penguins we find the wings formed essentially and *par excellence* as paddles; here is the *ne plus ultra* of the conversion of wings into instruments of aquatic progression. We may now turn to another modification of these organs. On surveying the duck tribe generally, we find them capable of rapid flight, sustained by quick strokes, and often at a great elevation in the air; but among this tribe there is one species the wings of which are so reduced as to be useless as organs of flight, while, although they aid in aquatic progression, they are rarely, if ever, called into action as oars; this bird is the loggerhead duck (*Anas brachyptera*) of the Falkland Islands, a large species weighing upwards of twenty pounds. "These birds," observes Mr. Darwin, "in former days were called, from their extraordinary manner of paddling and splashing upon the water, race-horses; but they are now named, much more appropriately, steamers. Their wings are too small and weak to allow of flight, but by their aid, partly swimming and partly flapping the surface of the water, they move very quickly. The manner is something like that by which the common house duck escapes when pursued by a dog, but I am nearly sure that the steamer moves its wings alternately instead of both together as in other birds. These clumsy loggerhead ducks make such a noise and splashing that the effect is exceedingly curious. The steamer is able to dive only a very short distance. It feeds entirely on shell-fish from the kelp and tidal rocks; hence the beak and head, for the purpose of breaking them, are surprisingly heavy and strong—so strong indeed is the head, that I have been scarcely able to fracture it with my geological hammer."

As another instance we may adduce the New Holland musk duck (*Hydrobates lobatus* or *Biziura lobata*), one of the most extraordinary birds of the *Anatidæ*. The wings in this bird are short and inadequate for the purpose of flight, but, as Mr. Bennett informs us, "assist the animal as it runs over the water." The tail is short, wedge-shaped, and composed of stiff feathers. The musk duck is a very wary bird, diving the instant it is approached; afterwards it only elevates its head to watch proceedings, disappearing again on the least sign of danger. It dives in pursuit of its finny prey, and while quickly swimming the whole body is submerged. In all these respects it greatly differs from the loggerhead duck, and approximates to the great auk. It is extremely awkward on the land, from the backward position of the limbs.

Between the brevipennate birds of the land and of the water, there is this difference, as it respects the use of the rudimentary wings: In the ostrich, emeu, and rhea, which are fleet-footed, the wings are chiefly of use as balancers. As the birds scour along these organs are expanded, apparently on purpose to catch the wind, but in reality they act to a certain degree like the arms of a man while running; yet it may be that they give some portion of buoyancy to the heavy body. In the cassowary, the small pinions tipped with stiff shafts are of no advantage to the bird as aids in progression; but we believe that it strikes with them as well as with its feet in self-defence. The cassowary is not a scourer of the plain. In the apteryx the wings are so reduced as to be utterly useless. On the contrary, in all the brevipennate aquatic birds, the wings are destined for a most important and special purpose; they are decidedly locomotive organs, as valuable to their possessors as are his sail-broad pinions to the soaring vulture. They subserve no trifling or secondary purpose, they are what the flippers are to the whale, the wing-like paddles to the marine turtle. The flight of these birds is in the water, as is that of others in the air, and all their structure is in harmony with the denser element, in which they disport at ease, and from the scaly or molluscous tenants of which they derive their sustenance. Were we to cut every plume away from the wings of an ostrich, it would still scour the desert; were we to deprive the wings of the great auk of their rigid feathers, we should render the bird powerless.

Again, in all brevipennate terrestrial birds, the legs are developed to their maximum; in all brevipennate aquatic birds the legs are undeveloped, and play a secondary part only in locomotion. On land they barely enable the bird to waddle or shuffle along; in the water they may serve as balancers, or as rudders, but are often most effective as organs of propulsion.

W. C. L. MARTIN.

HOW TO USE THE THERMOMETER.

Having provided good instruments, and placed them properly on their stand, the next essential is to record the readings correctly. In reading off an upright thermometer, it is requisite to keep the eye at the same elevation as the top of the column of mercury, otherwise the reading will be too high or too low, according as the eye is below or above the level. The same caution is requisite with those that are hung or placed horizontally, the eye must be exactly opposite to the top of the mercurial column, a little to the right or to the left would give similar errors. This is more especially named, as it is seldom attended to by ordinary observers.

To find the amount of terrestrial radiation, the readings of a thermometer placed on the grass must be deducted from those of another thermometer hung four feet above the grass. Thus, supposing the temperature on the grass to be 26·6°, and that at four feet to be 37·2°, then the amount of terrestrial radiation will be 10·6°. To find the amount of solar radiation, the temperature of a thermometer hung in the shade must be deducted from that of a thermometer with a *blackened bulb* hung in full sunshine; and this will vary according to the height at different seasons of the year. Thus, two thermometers placed at four feet, the one in sunshine will always give a greater degree of heat than that in shade; but if two thermometers are placed in sunshine, the one at four feet and the other on the grass, then the one on grass will give a higher reading in summer and a lower reading in winter than that at four feet, the two reading almost alike for a short time in spring and autumn.

To ascertain the daily range of temperature, the greatest cold is deducted from the greatest heat. Thus, if the temperature rises to 65·2° and falls to 34·5°, then the range will be 30·7°; the mean daily range being the mean of all the minimum temperatures deducted from the mean of all the maximum ones.

To obtain the mean temperature, there are several corrections to be used in order to ascertain the *true mean.* An approximate mean can be obtained by two different sets of readings, and the mean of these two sets is the *adopted mean.* From a series of observations made every two hours, day and night, at the Royal Observatory, Greenwich, Mr. Glaisher has constructed a table which gives the excess or defect from the mean of the twenty-four hours for each hour in each month. Thus, supposing for the month of December observations were made every morning at nine o'clock and every evening at ten o'clock, and that the sum of each set of readings was divided by 31 (the number of days in the month), and gave a mean for 9 A.M. of 35·2°, and for 10 P.M. a mean of 35·5°; and that the correction for December at 9 A.M. was + 0·9°, and for 10 P.M. + 0·5°. Then—

35·2°	+ 0· 5°
35·5°	+ 0· 9°
2)70·7°	2)0·14°
35·35°	+ 0· 7°
+ 0· 7°	
36·05°	

36·05° = approximate mean for the month, from observations taken at 9 A.M. and 10 P.M.

The other approximate mean is found from the sum of all the readings of the minimum thermometer divided by the number of days, and the same of all the readings of the maximum thermometer, with a certain deduction to be now named. Mr. Glaisher states that if the half of the maximum and minimum readings is taken, and the following correction applied subtractively, this will give an approximate mean :—

For January	0·2°	For July	1·9°
„ February	0·4°	„ August	1·7°
„ March	1·0°	„ September	1·3°
„ April	1·5°	„ October	1·0°
„ May	1·7°	„ November	0·4°
„ June	1·8°	„ December	0·0°

Thus, if for the same month the mean of all the maximum readings is 41·0°, and that for all the minimum readings 30·4°, then—

30·4°
41·0°
———
2)71·4°
———
35·7°
0·0° = correction for diurnal range.
———
35·7° = approximate mean from self-registering instruments.

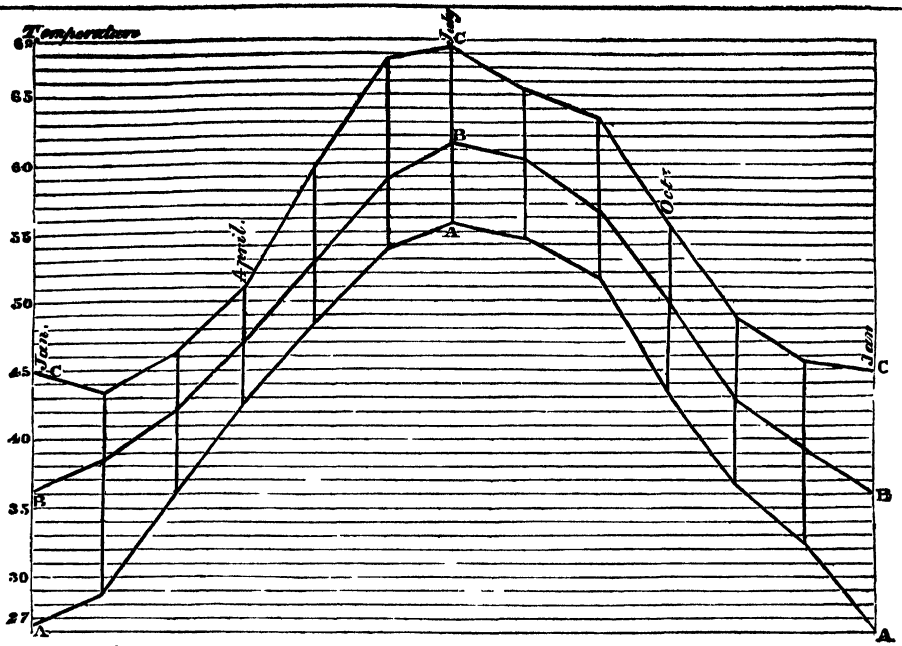
Having, by these two series, found that the approximate mean temperature is 36·05° and 35·70°, the mean of the two (35·87° or 35·9° nearly) is the adopted mean.

As the above corrections are based upon the Greenwich observations, and as different places vary in their range of temperature, it seems desirable that a new set of tables should be constructed from the table of Factors (Table III.) of Mr. Glaisher's "Corrections of Monthly Means;" and, indeed, for obtaining the correction to be applied in order to find the adopted mean of *a day* instead of *a month*, it is absolutely requisite to apply one based on the range of temperature of that day, because if for January 15th we used the correction for 9 A.M. and 10 P.M. (given in Table II.), which is + 0·8°, this would only be correct when the diurnal range was 8°; if the range happened to be 20°, the correction should really be + 2·0°; or, if 30°, + 2·9°. It would occupy too much space to enter more fully into the details of these tables, and as every observer must necessarily procure a copy, the reader is referred to them.

The following table of the mean temperature of the past fifty years will be an appropriate addition to a paper upon thermometers. From the year 1810 to 1840, the late Matthew Needham, Esq., took careful daily observations at 8 A.M. and 11 P.M. These records came into my possession, together with the instruments from which they were recorded. Having applied the requisite corrections for diurnal range and index error, the following table has been constructed. My own observations commenced in 1840, and are continued up to the present time. It is essential to state that Mr. Needham's station was only 200 yards from the Highfield House Observatory. In the following months the observations were not carried on every day, therefore an estimation has been made as regards these months:—April, 1828; May, 1813, 1815, 1817, and 1818; June, 1813, 1815, 1817, and 1818; July, 1810, 1815, 1817, and 1818; August, 1810, 1815, 1817, and 1818; September, 1810, 1815, 1817, and 1818; October, 1810, 1813, 1815, 1817, and 1826; and November, 1810 and 1815. In the months of December, January, February, and March there are no breaks in the observations, and only a few days in April and November.

At the foot of the table will be found the mean of thirty-one years from Mr. Needham's observations, and also of twenty years from my own; as well as from each ten-year period, and for the whole fifty years. In comparing the years 1810 to 1849 with the same period at the Royal Society, it is found that at Highfield House—

January	is 0·3°	warmer than Greenwich.
February	is 0·1°	„
March	is 0·7°	„
April	is 1·7°	„
May	is 0·9°	„
June	is 0·4°	„
July	is 0·0°	„
August	is 0·1°	„
September	is 0·1°	„
October	is 0·2°	colder than Greenwich.
November	is 0·4°	„
December	is 0·3°	„



MEAN TEMPERATURE OF THE PAST FIFTY YEARS AT HIGHFIELD HOUSE OBSERVATORY.

The curve B B B is the mean of each month for 50 years.
The curve A A A shows the coldest month of 50 years.
The curve C C C shows the hottest month of 50 years.

The diagram is intended to show the curve of mean temperature of each month, and how far this mean has varied, hotter and colder, from this mean.

HOTTEST MONTH.

	Temperature	Above the Mean of 50 Years
January, 1834 . .	45·1°	8·5°
February, 1817 .	43·5°	4·9°
March, 1822 & 1830	46·6°	4·5°
April, 1814 . .	51·1°	3·8°
May, 1848 . . .	60·0°	6·9°
June, 1846 . . .	67·7°	9·0°
July, 1846 . . .	68·4°	7·1°
August, 1826 . .	64·3°	4·0°
September, 1846 .	63·2°	6·6°
October, 1831 . .	55·2°	5·8°
November, 1818 .	48·8°	6·4°
December, 1828 .	45·7°	6·5°
Year 1846 . . .	52·3°	3·5°

COLDEST MONTH.

	Temperature.	Below the Average of 50 Years.
January, 1814 .	26·7°	9·9°
February, 1855 .	28·4°	10·2°
March, 1815 . .	35·6°	6·5°
April, 1837 . . .	42·3°	5·0°
May, 1856 . . .	48·5°	4·7°
June, 1821 . . .	53·8°	4·9°
July, 1841 . . .	55·5°	6·2°
August, 1845 . .	54·6°	6·2°
September, 1845 .	51·4°	5·2°
October, 1842 . .	43·2°	6·2°
November, 1851 .	36·4°	6·0°
December, 1846 .	32·5°	6·7°
Years 1841 & 1855	46·2°	2·6°

GIVING A RANGE FOR—

January . .	18·4°	August . .	10·2°
February . .	15·1°	September .	11·8°
March . . .	11·0°	October . .	12·0°
April . . .	8·8°	November .	12·4°
May . . .	11·6°	December .	13·2°
June . . .	13·9°	Year . . .	6·1°
July . . .	13·3°		

METEOROLOGICAL OBSERVATIONS MADE AT AND NEAR THE HIGHFIELD HOUSE OBSERVATORY.

MEAN TEMPERATURE OF EACH MONTH, FROM 1810 TO 1859.

Year.	Jan.	Feb.	March	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1810	35·1	38·2	41·0	48·1	48·8	58·3	61·0	61·0	59·6	52·2	42·8	39·3	48·78
1811	34·4	40·2	45·4	50·1	58·1	58·1	62·9	60·2	58·4	55·1	45·3	37·3	50·47
1812	37·3	41·6	40·8	43·6	54·0	57·0	59·9	59·1	56·6	49·3	41·3	36·0	48·04
1813	35·4	42·9	45·4	48·0	53·5	56·9	61·1	60·7	58·7	47·7	40·2	37·0	48·89
1814	26·7	34·2	38·6	51·1	49·9	55·6	62·3	60·0	56·1	47·7	40·5	39·9	46·88
1815	32·1	43·2	46·3	48·4	55·9	58·7	60·0	60·9	62·5	51·8	38·9	35·0	49·47
1816	36·8	34·5	39·5	45·0	50·9	56·3	57·8	57·8	53·8	50·7	39·0	36·5	46·55
1817	39·4	43·5	42·8	46·4	49·1	59·8	57·8	55·9	55·7	45·4	48·7	35·7	48·35
1818	39·7	36·1	41·0	46·1	53·7	63·6	66·3	64·1	60·9	54·0	48·8	37·1	50·95
1819	39·0	39·2	45·1	49·3	55·9	58·5	62·5	63·9	56·5	50·1	39·5	35·0	49·57
1820	30·6	38·1	40·8	49·8	53·8	58·4	61·0	59·8	55·6	47·5	41·5	40·6	48·12
1821	38·5	34·9	43·1	49·9	49·9	53·8	58·6	62·1	59·7	50·6	46·8	42·9	49·26
1822	40·9	42·7	16·6	48·9	56·5	62·8	61·1	60·1	56·1	51·3	46·8	33·7	50·62
1823	31·5	37·7	40·7	45·7	55·9	55·6	59·3	59·6	54·4	17·5	44·9	40·3	48·84
1824	39·8	40·6	41·4	46·9	52·7	58·8	63·0	60·9	58·7	50·2	45·4	41·1	49·85
1825	39·1	38·8	11·7	49·4	54·5	58·2	63·8	62·7	61·1	52·5	40·6	40·3	50·22
1826	32·0	43·4	42·4	49·8	54·2	63·6	64·9	64·3	58·1	52·8	40·8	43·2	50·79
1827	34·8	33·3	44·3	49·7	55·0	58·6	64·1	60·5	59·1	53·4	43·8	44·4	50·92
1828	40·6	41·0	41·9	48·6	55·8	60·8	62·1	61·4	58·8	50·7	45·6	45·7	51·33
1829	32·3	39·5	41·3	45·9	55·5	57·7	59·9	59·9	53·8	47·8	39·6	33·9	47·26
1830	33·3	35·8	46·6	50·4	54·6	56·9	62·9	57·4	54·6	52·0	41·0	35·2	48·64
1831	35·9	39·2	46·1	50·8	53·5	60·8	63·3	63·2	57·0	55·2	41·8	42·8	50·80
1832	37·5	37·5	43·6	48·4	53·1	59·1	60·5	60·2	56·0	51·3	40·9	41·3	49·12
1833	35·0	42·2	38·9	47·8	59·6	58·7	60·7	57·0	53·6	50·1	42·9	44·0	49·21
1834	45·1	41·0	44·9	47·1	55·2	59·7	63·5	61·1	58·0	49·8	43·7	43·1	51·02
1835	37·0	43·1	43·7	47·3	52·9	59·1	61·2	62·5	56·5	48·1	44·0	36·9	49·36
1836	37·0	38·3	43·4	46·5	52·5	60·5	60·6	58·3	54·0	47·5	41·0	39·6	48·41
1837	38·3	40·6	36·8	42·3	50·8	59·2	61·6	59·9	55·2	49·3	39·6	41·6	47·85
1838	29·3	32·2	41·8	44·3	50·6	58·5	60·4	60·2	55·4	49·8	39·4	38·2	46·67
1839	36·5	38·6	40·4	45·3	49·6	58·2	60·7	59·5	58·8	49·0	45·0	38·9	48·37
1840	39·5	38·1	39·6	49·9	53·5	59·7	57·9	62·6	54·3	47·2	43·4	38·0	48·22
31 Years' Mean	36·20	39·04	42·53	47·77	53·53	58·73	61·38	60·55	57·05	50·25	42·79	39·18	49·09
1841	32·1	35·0	45·1	46·8	55·7	54·0	55·5	57·8	54·6	43·5	38·4	38·2	46·22
1842	31·4	38·5	40·7	47·4	49·6	58·2	58·7	61·8	56·7	43·2	43·0	45·0	47·85
1843	38·2	34·3	42·5	48·2	51·0	55·9	59·5	59·8	58·1	45·7	41·4	43·8	48·20
1844	38·7	33·8	40·2	49·7	52·7	59·4	60·4	56·1	51·5	46·5	43·2	33·0	47·35
1845	38·2	33·3	35·6	48·9	50·8	58·3	59·5	54·6	51·4	48·4	44·8	39·7	46·96
1846	43·2	43·2	43·5	48·7	57·3	67·7	68·4	65·3	63·2	49·5	45·6	32·5	52·31
1847	34·6	36·8	43·7	45·9	59·3	62·1	67·8	61·4	53·6	53·1	45·9	43·6	50·65
1848	34·9	43·3	43·0	47·1	60·0	59·3	61·5	57·6	56·6	50·8	42·4	42·5	49·92
1849	38·6	40·9	41·1	43·0	52·9	55·5	59·8	60·2	55·3	45·8	39·8	36·8	47·50
1850	32·1	43·2	40·0	47·4	49·7	60·0	60·2	57·9	53·9	46·3	44·0	38·6	47·77
1851	41·1	39·2	41·6	45·1	51·3	56·7	58·6	59·7	51·5	50·5	36·4	40·1	47·90
1852	39·4	40·0	40·8	46·3	51·5	57·0	66·8	61·2	54·7	46·0	44·7	44·6	49·42
1853	40·2	32·6	37·9	46·8	50·4	58·3	59·1	57·6	53·5	48·8	38·9	34·4	46·54
1854	37·0	39·2	43·7	46·4	50·0	55·2	59·4	59·4	56·9	47·6	39·7	40·7	47·93
1855	36·1	28·4	37·0	44·9	49·6	56·2	60·0	60·7	56·2	48·6	41·1	35·8	46·22
1856	37·6	41·5	39·2	46·1	48·5	56·2	59·4	62·4	54·0	50·8	40·6	39·1	47·95
1857	35·9	39·2	41·4	45·5	52·5	60·9	61·3	63·2	58·4	52·1	43·9	44·4	49·72
1858	37·5	35·2	42·2	46·0	52·5	64·4	60·6	62·0	58·6	49·4	39·9	39·6	47·32
1859	39·7	42·1	45·3	45·0	52·3	58·8	65·2	61·7	55·2	48·4	40·4	34·0	49·01
20 Years' Mean.	37·30	37·79	41·22	46·75	52·55	58·69	60·98	60·15	55·77	48·11	41·87	39·22	48·27
10 Years' Mean. 1810 to 1819	35·59	39·36	42·62	47·61	52·98	58·19	61·16	60·36	57·88	50·40	42·50	36·88	48·79
1820 to 1829	36·01	39·00	42·64	48·46	54·38	58·83	61·78	61·16	57·64	50·43	43·58	40·61	49·62
[illegible]	36·66	38·85	42·62	47·02	53·24	59·07	61·54	59·93	55·91	50·21	42·23	40·16	48·94
[illegible]	36·94	39·52	41·53	47·56	54·28	59·01	60·90	59·72	55·83	47·37	42·79	39·81	48·56
[illegible]	37·26	38·06	40·91	45·95	50·83	58·37	61·06	60·58	50·59	48·85	40·96	39·13	47·98
10 [illegible]	36·57	38·56	42·06	47·32	53·14	58·69	61·29	60·35	56·57	49·45	42·41	39·22	48·78

E. J. LOWE.

COINS OF EARLY BRITISH PRINCES.

IN a previous article I have attempted to describe the series of coins struck by the British tribes and their princes, previous to their intercourse with the Romans. These coins, as I have shown, were purely imitative, both as to their value and devices. They had, in fact, no national character, except that arising from an unimportant peculiarity of fabric, which was probably accidental.

It was not till after the invasion of Cæsar that the coinage of Britain began to assume a more or less national character. The Roman leader did not attempt the subjugation of the British tribes, with the exception of a demand for a certain amount of annual tribute, and a nominal acknowledgment of a kind of suzerainty in the government of Rome.

The principal consequence, therefore, of the intercourse thus established was a decided stimulus given to all the arts of civilization. Among the most remarkable of the results thus effected in the development of the arts among these semi-barbarous tribes, was that which led to the changes which took place in the character of their national coinage: which thenceforward was no longer considered merely in the light of an article of public utility, but became, as in more civilized countries, a kind of badge of sovereignty, whether through the medium of a prince or a municipality, the name of a prince or a city being placed upon the coins of each petty state, as had long been the case in many parts of Gaul.

It would, perhaps, be impossible to divide the new British coinage into two distinct classes, as that of princes and that of cities, as may be done with the coinage of great part of Gaul of a similar epoch; but, nevertheless, there are authentic examples which, from their general character, may, undoubtedly, be placed in each of these categories. I shall, therefore, speak of both separately, although the coins bearing the names of cities may, after all, have been struck by princes, the name of the town merely indicating the place of issue.

The description of the coins of princes must necessarily take precedence of that of the coins supposed to be of civic origin.

Considering the undoubted authenticity of the coins in question, which are very numerous, and which bear the names of several sovereigns, who appear to have reigned in some splendour over extensive districts, it appears somewhat strange that few of the princes whose names thus occur upon coins are mentioned in history; that is to say, in detail, for there are a few scattered historic allusions which have been thought to refer to Tasciovanus, Commius, and a few others. Of these, the coins of Tasciovanus are, perhaps, the most ancient, and those bearing his name, as having first led to the discovery of the true meaning of a certain form of inscription which pervades the series after his reign, and which had long remained unintelligible, are, perhaps, the most interesting.

Tasciovanus appears to have reigned over several districts, the principal one being that of which Verlamio was the capital. The British Verlamio was the Verulamium of the Romans, situated at the foot of the hill on which the modern St. Alban's is built.

That Tasciovan was the father of the better-known Cunobelin is well ascertained from the evidence of the coins struck by the last-named prince. The name of Tasciovan has been thought to be a partially Latinized corruption of the Welsh word Tyoysog, signifying prince, or rather commander, as the Roman term *imperator*. It may, perhaps, have been a translation of the ancient British or Welsh into the modernized dialects of the less remote provinces, just as the name of Augustus was rendered by the equivalent Greek term Sebastos, on coins struck during his reign, in the Greek provinces of the Roman Empire. The names given to the father of Cunobelin by the chroniclers are unfortunately very various, but they all begin with T, the one on the coins struck during his reign being undoubtedly the authentic one.

This Tasciovan, or, as the Romans Latinized the name, Tasciovanus, is possibly the chieftain referred to by Cæsar, under the name of Taximagulus,* that is, *Tascio Magol*, the great chief; but no facts of interest are disclosed by the Roman commentator concerning him. Perhaps, indeed, the chief who resisted Cæsar was the one called Tasgetus, and not the same person as Tasciovan. One of the most interesting coins of Tasciovan is a gold piece, on which the unmeaning debasement of the head of Apollo, of the Macedonian staters, has disappeared to make room for the portrait of the British chief, which is executed in a bold but hard style, not unlike that exhibited on the coins of the Gaulish kings of the Bosphorus. On the reverse, too, this coin is without the corrupted device of the biga; in place of which is a rather rude figure, seemingly intended for a hippocampus, or sea-horse. A somewhat similar animal is frequently found on Greek coins of maritime states, from one of which the present device may have been copied, though what connection such a symbol can have had with the inland states of Tasciovan it is difficult to imagine; the explanation being probably that it was an arbitrary copy of the device on a foreign coin, adopted without regard to its especial fitness.

That it is a copy of a Greek device is the more probable, from the circumstance that the letters V E R, the commencement of Verlamio, the capital of Tasciovan, are often found beneath it, in the same manner as the initial letters of Greek cities; as on the coins of Ægina, for instance, which have A I or A I G placed on each side of the tortoise, which was the national device of that state.

On the obverse there is no inscription, as is the case with most of the Greek coins of princes, but on the reverse the initial letters TAS occur. Other coins of the

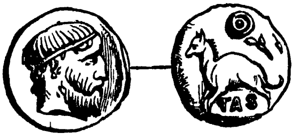


Fig. 1.

same prince have TASC, some TASCIO, and others TASCIOVAN in full; but none of his own coins have the Romanized form of the name, as TASCIOVANUS.

Notwithstanding the original character of the coin just described, others of the same prince have, on both sides, mere modifications of the old types of the "Philips." The engraving below is an example of this class of the coins of Tasciovan. On the reverse the horse of the biga device is unmistakable, in consequence of the presence of the *wheel*, which is, as usual, in the later debasements, placed above

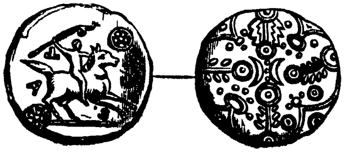


Fig. 2

the horse. The great innovation in this form of the device is the introduction of the horseman, doubtless representing the chief himself, who holds above his head a crosier-like instrument, which is probably an emblem of command, or possibly merely a weapon; or perhaps, the figure, though here made to represent the British chief, was suggested by the charioteer of the biga device, in

* Mr. [illegible]h, however, thinks that Taximagulus was a [illegible]ce, and not Tasciovan.

which case the instrument he holds above his head may be but an altered copy of the goad or whip carried in a somewhat similar position by the driver of the biga. The scattered inscription is TASC. The other side of this coin, which, as being without inscription, is doubtless intended for the obverse, has for device the debased head of Apollo, reduced to a mere cruciform ornament, of which fragments of the laurel form the chief feature, as alluded to in the paper on the *anepegraphic* coins of this series.

The TAS or TASCIO, etc., and the VER of these coins gave rise to very singular and ingenious conjectures among our early antiquaries, before sufficient data had been recovered and collected, to lead to a searching investigation.

Camden, in speaking of the devices and inscriptions of these coins, and in reference to the word TASCIO, calls it "a phrase of the Mint, signifying tribute-money, among the Britons," adding, that he is confirmed in his conjecture by information received from Dr. David Powel, "a perfect master of the British language," who had made known to him, at the same time, that it was probably derived from the Latin word *taxatio*, and spelt TAsc to represent the letter x, which was then unknown to the Britons. The eminent antiquary admits, at the same time, that he cannot say much on British coins, as "the subject is involved in the darkness of so many ages."

Some have been led to the conclusion, by an extraordinary but very excusable accumulation of confused ideas, that the word Tascio represented the name of a moneyer, or mint-master of Cunobelin, as being found on coins in conjunction with the name of that prince —a fancy of our early numismatists which is now thoroughly exploded.

The coins which have only Tascia, or Tasc, or Tasciovan, without the name of another prince, are generally of ruder workmanship than those which have Tascia combined with other names. It may be noted that those with the abbreviated name of Tasciovan alone are only found in the neighbourhood of St. Alban's, which is close to the site of the ancient Verlamio. Many of the most interesting of the coins found on that site were formerly in the collection of Mr. Brown, of St. Alban's, and some of them are now in our national cabinet in the British Museum. Some of these have two profiles, one lying over the other, the second profile being, probably, either that of a queen, or that of a brother or son associated in the government.

The coins of Tasciovan having TASCIO, with the additional VER, are considered to be those struck at Verlamio; those with the addition of SEGO, at Segontium, another mint-town of his dominions, situated in the Hampshire and Surrey regions, over which he ruled. Those with TASCIO and RIXON are supposed to have been struck at some unknown city; not Uriconium,* which no stretch of conjecture can bring within the dominions of Tasciovan. The VER has also been misinterpreted as the beginning of Vergobrete, a Celtic term, meaning a chief or prince, upon which fragile foundation, taking also Tasciovan to mean imperator, the coins of Tasciovan with the TASCIO . VIR . BOD might be declared coins of Boadicea, this abbreviated inscription being translated as "the female Vergobrete Boadicea the Ruler." But the recent accumulation of evidence, such as that adduced by Mr. Birch, Mr. Evans, and other indefatigable numismatists, at once places such fanciful hypotheses out of the pale of probability. The VER . BOD, which sometimes accompanies the name of Tasciovan, is thought rather to be the name of a town, but not Verlamio, as such coins are never found in that neighbourhood, but may be possibly

* Uriconium was the capital of the Cornarii (afterwards Wroxeter), on the site of which the most interesting antiquarian excavations which have ever taken place in England are now being carried on.

assigned, as suggested by Mr. Evans, to a city bearing some such name as Verbodunum. Coins attributed to Tasciovanus, upon sufficiently satisfactory evidence, have now accumulated to a sufficient extent to enable numismatists to class them distinctly into gold, silver, copper, and brass. The gold and silver have each their subdivisions of halves and quarters, and the copper and brass their halves, and possibly some lesser subdivisions. These coins exhibit a considerable variety of types, but all more or less of the style and form of the examples given. The largest copper have generally a square ornament on one side, surrounded by the word VERLAMIO,* the smaller size having the ornament without the letters, or only with four of them, while some have a rudely-executed eagle holding a branch, and having the inscription VERLAMIO more or less complete.

Tasciovan probably reigned from about 60 B.C. to about 20 B.C. Cæsar's second invasion having occurred in 55 and 54 B.C., and Cunobelin, son of Tasciovan, having been sent to receive his education at the court of Augustus, whose reign did not commence till 30 B.C., render these dates probable. Some numismatists, however, are of opinion that the reign of Tasciovan did not commence till after Cæsar's invasion.

Among other native princes who are said to have opposed the landing of Cæsar is Segonax, to whom the coins, bearing the name of Tasciovan, with the word SEGO, were formerly attributed, the name of Tasciovan being thought to allude to tribute paid by Segonax and others, according to the truce or peace agreed upon with Cæsar—"Quid in annos singulos vectigalis P. R. Britannia penderet.†" This passage contains another proof (in addition to the more celebrated passage), if that were necessary, that the Britons possessed coined money at that time, the word *vectigal* being never employed except when actual money is referred to. No coins yet discovered, however, can, with any show of probability, be attributed to Segonax.

Commius is the name of another prince, probably contemporary with Tasciovanus. To this prince several coins have now been attributed with tolerable certainty. The name was, however, for some time considered to refer to a commonwealth or community, and to be founded on the Welsh word *cwommwd*, or *cymmwd;* and it is thought that the word was introduced on the coin in the same manner, and with the same import, as the Greek word KOINOS on a series of coins struck for the use of a certain set of cities forming together one community; or, the Roman term *communitas*, which is found on certain provincial coins struck under similar circumstances. The community supposed to be referred to on the British coin was that of the Southern Belgic tribes, occupying a region comprised in the present Wiltshire and Dorsetshire. Mr. Beale Poste, in an ingenious paper read before the Numismatic Society, supposed the word Commius to mean at once a community and the chief who was at the head of it, adducing as proof of his hypothesis that Cæsar especially mentions the "Commius," or head of a confederacy in Gaul. It is true that the Saxons had also the term *commagil* for the chief of a confederacy. Upon such consideration the COMMI . F, found on the coins of a son of Commius, was interpreted by that numismatist as *Commi(os) F(irbolgi)*, that is, the community of the Firbolgi, who are described by Mr. Beale Poste as a tribe of the Southern Belgi. It is, however, pretty generally admitted in the present day, that the COMMI found on the British coinage is merely the name of a prince, and very probably belongs to Commius, the Attrebatian mentioned by Cæsar as ruling over the Attrebatii of Gaul. Or, the coins in question may be those of a prince of the same name, who ruled over the

* The Verulamium of the Romans.

† Bell, Gall. v. 22.

branch of the Attrebatii who had settled in Britain.

This view was partially adopted by our famous old archæologist Camden and his brother antiquary, Philemon Holland, who were both in favour of the hypothesis that the Commius in question was the Gallic prince mentioned by Cæsar. The theory by which the name was made, not that of a person, but having reference to a community, had not been broached in their time. Thus, "Both I and others," says Camden, "are pleased with the conceit that it is a coin of Commius Attrebatensis, whom Cæsar mentioneth." The Commius mentioned by Cæsar, who had acknowledged his authority over the Gaulish Attrebates, had been more than once a mediator between Cæsar and the British chiefs, from which circumstance it may, perhaps, be inferred, that he held authority also over that portion of the Attrebates who had settled in Britain, and had in that capacity issued the British coins (only found in this county) which bear his name. That the holders of authority over separate portions of a tribe, one remaining in Gaul and the other settled in Britain, is not without precedent, we know from the case of Diviaticus, who is well known to have ruled over portions of Britain as well as Gaul. The Gallic Commius, as recorded by Frontinus, took refuge for a time in Britain during a rupture with the Romans, and it may have been during that time that coins were issued by the British Attrebates bearing his name.*

Considering all these somewhat conflicting circumstances, one would be rather inclined to assign the British coins bearing the name of Commius to a strictly British prince of that name, as there are well-authenticated coins of three British princes, who describe themselves on their coins as Sons of Commius.

The coin represented at Fig. 3 is one of those now attributed, by most British numismatics, to a British Commius. It has the letters **MMIOS** beneath and in front of the horse, the CO being off the coin, on account of irregular placing of the die. The termination in *os* may be accepted as proof that Commius, or rather Commi*os*, was at least contemporary with, if not earlier than, Tasciovan; as the Greek termination in *os*, common in Gaul and parts of Britain just before the invasion of the Romans, was entirely superseded by the Roman *us* after that period.

FIG. 3.

Addedomaros is another British prince of this epoch whose name has been preserved on British coins. The termination in *os* is conclusive as to a higher degree of antiquity in British names than those ending in *us;* but, perhaps, the purely barbaric Tasciovan, without the euphonic termination either in *os* or *us*, should take precedence of both.

The coin engraved at p. 27, Fig. 3, is one of those bearing the name Addedomaros. The name is clear enough to experienced readers of monetary legends, though all the letters are only half on the coin, which is of red gold, and weighing 86 grains. The ornament on the obverse is a barbaric degradation of the head of Apollo of the "Philips." There are smaller pieces, weighing 21½ grains, of the same red gold, which have the name in full, and very distinct. They are probably quarters of the larger piece. There are also pieces bearing other types, with the name Addedomaros more or less distinct.

It has been ascertained, with tolerable certainty, that the termination *maros* always belongs to the name of a person, and not that of a people. These coins are therefore considered to be undoubtedly those of a reigning prince, and not civic coins, a class of early British money which I shall refer to in another place. The inscriptions are sometimes written with the letter Θ, sometimes Đ,

* The name of Commius occurs also on a coin of Gallia Narbonensis (*Lelewel*).

and sometimes D, the first two being doubtless the earliest and the D the latest, as we find on Gaulish coins of a corresponding period. Addedomaros was probably a prince of the Iceni, as the coins bearing his name are generally found in Norfolk and near Cambridge.

The name of Addedomaros does not occur in history, but he may probably be a descendant of, and bearing the ancestral name of Ædd-mawr, or Ædd the Great, of the Welsh chroniclers. This is the more probable as, in a similar manner, we can trace the name of Dubnovellaunus to the Welsh Dyfnawal or Durwallo, and that of Caractacus to a similar source. Of Ædd-mawr nothing is stated by the chroniclers in question, except that he was one of the progenitors of a long line of ancient British kings, which might lead, as just suggested, to the supposition that the Addedomaros of the coins bore the ancestral name of the founder of his line.

With regard to the date of his coins, in so far as it may be approximately ascertained by means of the Greek termination in *os* of the name of Addedomaros, it should be stated that there is a strange confusion in the use of the Greek or Latin terminations on early British coins; both the *us* and *os* occurring occasionally, though very seldom on the same coin. It may, however, be accepted as a general rule, that the Celts *first* Grecianized and *afterwards* Latinized their names, and that the Latinized terminations generally occur after the invasion of Cæsar. In 60 B.C., for instance, the terminations of proper names were generally in *os*, while about 40 or 50 B.C., after the Roman invasion, *us* began to prevail universally.

In like manner, the RIX of the earlier period becomes generally REX at the last-named epoch; but the time of transition is not so distinctly marked, and there are some striking irregularities to be noticed hereafter.

H. NOEL HUMPHREYS.

THE GENESIS OF ORGANIC FORMS.

WHATEVER may be said as to the limits of man's power in intellectual observation, it is quite certain that it is not through lack of courage that he is not by this time master of every secret of the universe. "The Celestial Worlds Discovered, or Conjectures Concerning the Inhabitants of the Planets," by Christianus Huygens, may go with Lake's Moon Story, as exemplifying the desire of man to overleap eternal barriers, and in disappointment searching in his imagination for what he cannot find in Nature. The great problem which modern scientific inquiry has chosen for solution is as to the origin of life on the globe, whether it is the result of distinct creation, whether it created itself, whether it has existed from all eternity, whether it is inevitably allied to form, whether form is only the visible expression of it, or whether it is a necessity of form, and, like gravitation or electricity, universally diffused throughout all material substances. It would be a pity not to have as many variations of this species of inquiry as possible, so we must allow license to those who question the fact of life altogether, and agree with them at least so far as to admit that, *perhaps*, like time and space, it is only an abstraction. The "rough-and-ready" method is to take things as they are, agree that life is a practical fact, even if we cannot define it, and that the forms in which life is manifested have an inevitable association with it, for the present at least, whatever may be said as to the past or the future. Quite a pretty library of books has sprung up as food for this inquiry, and not as food only, but as zests for appetite, and organs of digestion into the bargain, so that we may, if we choose, put out our thinking as we do our tailoring, and have any imaginable multiplicity of hypotheses served up to us in the style of compounded French dishes, and the less we inquire about the ingredients the better. In the style of the philosopher's conversation with the boatmen, we should say to the friend who has not read Darwin's "Origin of Species," "There's half your life gone." If he had not read "Vestiges of the Natural History of Creation," "There's another half your life gone." After that, of course we could not mention Gosse's "Omphalos," Dr. Dawson's "Archaia," Dr. Bree's "Species not Transmutable," Hugh Miller's "Testimony" and "Footprints," Mackie's "First Traces of Life," or any of the dilutions of Lamarck, travesties of Oken, or warped inferences from Owen, Lyall, and Murchison; for the simple reason that two halves make one whole. There is something of a charm, though, about this inquiry; it is a putting on trial of at least some of the elements of our faith; it is flattering to ourselves, and the mind always likes to have the Pegasus of imagination in the harness when it makes a bold drive along the dark ways of physical and metaphysical speculation. In plain truth, where we pretend to grope our way by the aid of pure reason alone, we are too often following the *ignis fatuus* of fancy, and ready to accept as the fruit of logic that which is the fruit of invention.

We are not about to lay down a doctrine, so let the reader take comfort, and with us ask the question—Whence came all the forms of life we see? In a certain place there is a distinct reply, but it is a condition of this inquiry that what Nature exhibits Nature must explain. Here, then, let us introduce our good friend, Mr. P. H. Gosse, who has done so much for sea anemones, for microscopic zoology, and, by his charming books on Jamaica and Alabama, for Observation as an instrument in the gathering of knowledge. Either the organic forms we behold around us have existed from all eternity, or they have each had a beginning. So says Mr. Gosse,* and there is no gainsaying him. Mere observation teaches that existing plants and animals had no beginning, because it is a necessary condition of an organic form, living or dead, to bear about it evidences of past duration. One illustration will suffice here. I write with a quill pen. I observe the quill, the vane, and shaft; the epidermic cells; the feather is the result of growth and development. With Mr. Darwin's sanction I may literally, as well as metaphorically, trace its origin to my brother, who was plucked, perhaps against his will, for my benefit. The feather did not grow instanter, it had its season of nourishment from the goose and comfort to it. Nor did the goose come to a condition to produce feathers instanter; and before feathers sprouted from their capsules, the whole complexity of goose and feathers was inclosed in the shell of an egg. The egg was the product of a goose, which was the product of an egg, which was the product of, etc. etc., *and so on for ever.* We promised not to lay down a doctrine, and we do not here say that Nature had no beginning; but *that*, at all events, is the conclusion to be arrived at by logical sequence, if the data are derived from observation only of any one particular organism. Mr. Gosse would put the matter still more forcibly thus: Suppose you have the privilege of inspecting the very first example of any particular organism—say, if you please, man himself—one instant after creation. He would bear about him all the marks of pre-existence; you would pronounce him a product of time, thirty years perhaps of growth about him, his hair, nails, teeth, ay, even the blood in his arte-

* "Omphalos: An Attempt to Untie the Geological Knot." By Philip Henry Gosse, F.R.S. Van Voorst.

ries, all testifying to an existence in the past. Your reason would tell you that he owed his existence to parentage, and away you go again after eternal succession, though an instant before such a creature had no existence. But an eternity of organic forms is, after all, only an intellectual fiction, the rough-and-ready reasoner will have a beginning, and is quite content to accept it even if bearing upon it false evidences of a past. The author of the "Vestiges" professes to help us out of the difficulty. An infinite succession of finite things we reject, and so there is provided instead the interesting suggestion of spontaneous generation. The mystery is solved, organization willed itself into being, and the only wonder is, that the book which brought such light into the world did not write and print itself. Let us be fair. *Ex nihilo nihil fit.* If existence cannot come from non-existence; if life cannot call itself when there is none to call, and nothing to be called; if a unit cannot spring out of nought, then "Vestiges" was written in vain, and to those who accept its doctrine we must say, "Your faith is vain, ye are yet in your sins." It might be harsh to judge "Vestiges" by the electrical experiments of Mr. Crosse, which men of sober thought and scientific experience agree in considering child's play, but the question must be pressed whence came the primordial germ which served as the typical seed-plot of all successive generations. "Give me a fulcrum," said Archimedes; "Give me an organic nucleus, a living cell," says the author of "Vestiges," and, *presto*, you shall in the course of a few billion eons have more plants and animals than you can ever hope to catalogue, with man at the head, the last and best fruit of successive developments, acknowledging the primordial cell as his remote, but honoured ancestor. It is a downright pity that Mr. Crosse and Mr. Weekes should have been favoured with acari, or mites covered with bristles, instead of primordial cells, because, instead of illustrating progressive development, the creation of life by electricity was rather a confirmation of Mr. Gosse's plan of prochronism—a bursting into the circle, or line, of the organic scheme, instead of a commencement at the very beginning. If these experiments were worth the paper on which they were solemnly recorded, the author would not have to repeat, in this new and beautifully illustrated edition,* that "we do not present the Crossian experiment, and other alleged cases of primitive generation, as undoubted facts, or as indispensable parts of the present hypothesis." We remember well reading the first edition of "Vestiges" on the very day it was first issued from the publisher. We have read it several times since, and there has always appeared to us an absolute necessity for spontaneous generation as a fact to give the Lamarckian hypothesis a fair claim to hearing. Given that, and transmutation may follow. If any philosopher can produce an acarus, or even an amœba, or the most simple cryptogamic cell, let him come forward and put to flight the armies of the aliens. We will not stone him or cast him out; we shall be lost in awe at beholding the bristly mite emerge from its silicated bath, and shall thenceforth be prepared to believe that between the infinite and the finite there is no gulf fixed. That "the basis of all vegetable and animal substances consists of nucleated cells," is no key to the mystery of life at all, any more than the production of foliated crystals proves the conversion, by qualities inherent in matter, of inorganic into organic entities. A poplar-tree may be "the brush realized" to perfection in the *imagination of the author*, but a fancied resemblance is not creative power. Organic bodies contain inorganic elements, we are told, in the chapter on "Particular Considerations" (p. 111); and, willing to admit as much as we can, we admit *that*. But you

* "Vestiges of the Natural History of Creation." Eleventh edition, illustrated. John Churchill.

see, if we resolve structures into their components, we must come to something more elementary than themselves, and the statement is on a par with one we venture to offer as a parallel, namely, that an arithmetical quantity consists of units; and the second statement is just as good as the first, for all that we gain of knowledge as to the origin of organization. Microscopists are not so puzzled about the origin of pencillium and its kindred as some people imagine, and they never give way even to a dream of spontaneous generation, even when a crop of infinitesimal fungi breaks out upon a clean glass slide.

It comes to this, we must give to the author of "Vestiges," and to Mr. Darwin also, a primordial germ. Give them an act of creation to start with, and they will build up the existing fabric without further help; they will show that man is but a monkey modified, the monkey but a transformed oyster, the oyster but an expanded rhizopod, and the rhizopod a grandchild of the created nucleus. Nay, there is the "secure future of equally inappreciable length," the certainty of further improvement, and the possible budding of angelic wings, and development of angelic attributes. The hypotheses of these two authors do not greatly differ. The "Vestiges" proceeds on the supposition that the primordial cell was gifted with an innate power of expansion. That the expansion, growth, development, call it what you will, is of a character which tends towards improvement or ascent in the scale of organization. To be just to the hypothesis, we must add that it is not necessary that any low form of life, which may be the presumed causal antecedent of more complicated forms, is in itself imperfect; it is simply contended that life is in its essence a transforming power, in virtue of which A changes by the operation of law into B, and B into C. Or, to adopt an illustrative example, when organisation has, by successive developments, produced a monkey from some primal germ, the monkey, with a laudable desire for improvement, compels his tail to shrink up into an *os coccygis*, his thumbs to become opposable, his countenance to lose the grin of the satyr, and acquire divine complacency, while his brain expands into human completeness by the mere exercise of his thoughts on the glorious change which the future has in store for him. The author puts the case differently, we admit, and with elaborate discussion on cumulative evidence; but it comes to this. "Life," he says, "pressed in as soon as there were suitable conditions" (p. 104), and those suitable conditions were presented in succession, and all the wondrous plan of adaptiveness in vegetable and animal existence was the result of "law," not of design; the fruit of a "tendency," not the response to the exercise of divine will. And here we are provided with a smooth and slippery path over all the obstacles that reason and experience might suggest in the supposed key to the process of development furnished by the history of embryos. "All organisms, vegetable as well as animal, commence with a simple cell, of which it is impossible to tell in any case to what form it is destined to advance. A series of changes takes place. First, of an animal embryo, we can distinguish whether it is destined for the radiate, molluscous, articulate, or vertebrate sub-kingdom. Take an embryo of the vertebrate sub-kingdom, we next trace in it the change which will determine whether it is to belong to the fish, reptile, bird, or mammal class. Take an embryo of the mammal class, the characters of the particular order are next determined. Afterwards those of family, genus, species, sex, and individual are evolved in succession." (P. 130.) If every germ has locked up within it the elements of the human form—a necessary postulate—then how is it that when organization has attained to the human standard, any lower forms remain? They are arrested, says the author, at some one stage in the embryonic process, so that a fish is a mammal with a swim-bladder, and a mammal a fish with lungs; a monkey is a man with a tail, and a man is a monkey with an opposable thumb, a habit of wearing spectacles, and not a word about the intermaxillary bone. So, from a nucleated cell which springs into being by a fortuitous concourse of atoms, the whole organic fabric is constructed on the principle of development from little to much.

Mr. Darwin's hypothesis is very nearly the same.* The breath of life was first breathed into a primordial form. There was expansion, of a typical kind at least, and the primordial germ, like Topsy, "growed." The only essential difference between the two authors is as to method and terms. Mr. Darwin is rather synthetical. He perceives among animated forms deviations from their types. He describes these deviations, multiplies instances, and works among his facts like a great naturalist, as he is. Variation, he concludes, is in accordance with law—the "Law of Variation." Every organic form has to "struggle for existence" against adverse circumstances, and in this struggle the strongest, the best fitted to contend against destructive influences, the most perfectly developed, survive by a process of "natural selection," and by this process of natural selection "all the organic beings which have ever lived on this earth have descended from some one primordial form, into which life was breathed by the Creator" (p. 484).

Vast as are the fields of inquiry over which we are invited to range by these remarkable works; delightful as it is to be led, even towards a mere hypothesis, through the domain of natural phenomena, strewn everywhere with wonders; lively as is the interest awakened by the analysis of analogies and resemblances, and, above all, by the conformity to types, of the great divisions of Nature, and of the agreement of types with types, and the possible relation of all types to one type; yet, when we come to results, the whole question is one of the permanency of species. If species are permanent, if they are as distinct entities, as oxygen and hydrogen, as the angles of a cube and the relations of a circumference to its diameter, then Lamarck and the "Vestiges" are only examples of scientific toying, and Darwin must be respected for his facts, and smiled at for his fancies.

Species have been variously defined. They are a sort of right lines in organic geometry. Cuvier says, "Species are the collection of all beings descended the one from the other, or from common parents." De Candolle includes as one species all the individuals which bear to each other so close a resemblance as to allow of our supposing that they have proceeded originally from a single pair. This last may suffice us here, with this proviso, that we do not care whether they have descended from a single pair or not; it is sufficient that the resemblances are such as to allow of our supposing that they have. The individuals of the same species must have certain uniform and permanent characters. However nearly species approach each other, there must be a visible line of demarcation—a possibility of determining, by physical tests, that this belongs to species A, and that to species B. The uniform characteristics must be transmitted to their offspring, so that by these we can trace them back to parentage, and predicate the nature of their progeny. The variations to which each species is liable must be included within the limits of its uniform characteristics, no matter by what means these varieties are developed.

On the hypothesis of the "Vestiges," species are transmuted by an initial force; on the Darwinian hypothesis we are referred to outward modifying circumstances, and have the key to the whole problem of organic form in a mule-canary, or a barn-door fowl, feathered to the toes. Variation takes place;

* "The Origin of Species by Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life." By Charles Darwin, M.A. Fifth Thousand. John Murray.

the variation is perpetuated; other variations are added, and, in process of time, these have accumulated so as to give the subject of them all the characters of a species, so that species are not typical entities, but mere transitionary states of life in process of improvement. Mr. Darwin writes delightfully about dogs, and pigeons, and horses, and humble-bees; but he fails to adduce any one example of the transmutation of species. We have records of the pigeon as a domesticated bird extending over 4000 years. We have pouters, fantails, runts, and other varieties, all pretty permanent in the hands of skilful breeders, but all given to one practice, for which Mr. Darwin ought to reprove them, that of running out if left to themselves, of reverting back to a certain specific type, as if the variations had been brought about by man's interference with the conditions necessary to the preservation of the species in its typical form, and as if those variations were limited in extent and number.* But the tendency to vary is evidently a matter quite distinct from the presumed tendency of species to change through variation; because, in this particular instance, the subjects of discussion are still pigeons. Then, as to dogs, we know that wonderful changes have been wrought in them, as to external appearance; but Canis is Canis still—he shows no disposition or tendency to become Vulpus or Lupus. If we were to ignore anatomy we should have a good test of species in all varieties of dog in the shape of the pupil of the eye, which, in the fox, contracts to an oval, in the dog it is round. The dog has been more subjected to modifying influences, and has undergone more variation, than any other animal that has had the attention of man, and is one of the most ancient of domesticated animals; and mark this, it is dog still; and if we had a scientific description of it as a species 4000 years old, it would agree with a description drawn up to-day, nothing more, nothing less. In pointing to the distinctions between varieties and species, Professor Owen says of the dog: "Under the extremest mark of variety so superinduced, the naturalist detects in the dental formula, and in the construction of the cranium, the unmistakable generic and specific characters of the *Canis familiaris*. Note, also, how unerringly and plainly the extremest varieties of the dogkind recognize their own specific relationship. How differently does the giant Newfoundland behave to the dwarf pug, on a casual rencontre, from the way in which either of them would treat a jackall, a wolf, or a fox. The dumb animal might teach the philosopher that unity of kind or of species is discoverable under the strongest mark of variation." Mr. Darwin may cite instances of variation till doomsday, but the philosopher will all the while repeat the request for at least *one* actual instance of transmutation. And can he furnish it? No! He believes, with Dr. Horner, that man has existed on the earth 13,000 to 14,000 years. Without raising the question of the antiquity of man, let us grant even this extravagant article of his belief, and what then? Suppose man has existed a billion, or a billion billion of years, what then? We really want to be carried back to the date when he came forth, in his complete humanity from the womb of an ape or chimpanzee. We want a record or evidence of the transmutation, or rather we don't want anything of the kind; for it might induce us to worship our thumbs and great toes, pull out our teeth, measure our fore-arms, and look wistfully behind us in fear that a certain benefit of variation might undergo reversion and betray us. The variation hypothesis comes to nothing without at least some one authentic case of A becoming a veritable B. Of the many pens that have been exercised in the analysis of Mr. Darwin's law of variation, none have so completely crushed it in the grasp of precise reasoning on sound data as that of Dr. Bree, who, to the qualifications of a thorough naturalist, a master of classification, and a careful observer, adds that of clear perception both in "rough-and-ready" methods and the more precise methods of the schools. In this work* the *rationale* of the Darwinian philosophy is thus tersely stated: "Go where we will, we find life, but always adapted to a special end, and formed for a wise purpose. All this we combine into a great scheme of creation, ordained and perfected by Infinite Wisdom. Adopt Mr. Darwin's theory, and what do we see? Through the gloom of myriads of ages we behold an 'unknown element of special creation,' uniting in itself the male and female structure. This primordial form has, by its liability to vary in its progeny, become the parent of every plant and animal in the world. We are now to see how long it remained sole tenant of the mighty world—how long the air and the deep waited for their creatures. We are led to suppose that, some time after it was called into existence, some one of its descendants exhibited, by mere chance, not by natural law, for a natural law cannot be partial in its operation—some slight variation. This alteration was transmitted to its offspring, and again it varied. As it can be pretty clearly proved that man has not varied towards a different form, at least during the historic period, it is clear these variations, slight as they were, must each have taken thousands, or even millions, of years to form. Never mind. Land, air, and water are patient; they still wait for their living tenants. At length our organism arrives at a point in which a 'struggle for existence' takes place. One class of descendants shows a decided tendency to '*vary*' into plants, another has an animal tendency. The animal, being the strongest, wins the day, and henceforth takes the lead, and we have perfected the first animal form! Happy in its defeat, the unconscious plant takes root in the earth, and we have the first vegetable structure. Of course these forms must be hermaphrodite. For countless ages they each go on increasing. Natural law plays her part well at first, and predominates. At length each form varies. The variation becomes permanent, and is transmitted from race to race. Gradually, one variation takes one form, another assumes a different one. The 'struggle for existence' in a world designed to be peopled goes on; myriads of ages pass; continents are destroyed and buried beneath the deep, carrying with them every transitional form by which posterity could recognize the power of 'natural selection.' The dawn of that geologic epoch, which we now call the first that came into existence, is attained. But all that has been arrived at by the 'laws of variation' are structures similar to those of reef-coral or sea-weed, oyster, nautilus, or woodlouse (tritobite). These, then, must have been the progenitors of the present race of man, and every animal on the face of the earth." And we will accept the conclusion when the right sort of evidence is placed before us, and *not till then.*

That species vary is an ancient fact, and it is also an ancient fact, admitted by Mr. Darwin, that "like produces like." Shall we escape from the difficulty of the boundary-lines, apparently drawn by Nature about all species, by taking refuge in hybridization? An unscientific observer at a cattle-show, or the fortunate possessor of a herd of pigmy Bretonne sheep or cows, might expect to see such a hypothesis as that of transmutation triumphantly established by the experiences of the cross-breeder. To model farm-cattle to an arbitrary standard is one thing, to get a race intermediate between any two species is another. The cattle-breeder works with varieties. His short-horns, long-horns, Devons, and Scots are all veritable oxen, and Bovis shows no sign of changing into Cervis; and if a hybrid be obtained between them, we have gone just far enough to learn the

* "Species Not Transmutable, nor the Result of Secondary Causes." By C. R. Bree, Esq., M.D., F.L.S. Groombridge and Sons.

extreme limits of species, and, by the extent of those limits, learn their definability—"Thus far, and no farther." To keep up the supply of mules for mountain roads, the same method is followed now as when man first discovered that he could modify organic forms. The sterility of hybrids is a patent fact, and we have the records of thousands of years to show that, even in this direction, the fixity of species is established. The source of error arises from forgetting that a species is a distinct idea in Nature; that all its variations are subservient to it; and that there is a constant tendency to revert to type, and to keep type true to its original character for ever.

We shall be referred to the geological record, and asked if we do not read therein a lesson of organic progression. The author of the "Vestiges" relies upon the stone-book just as Mr. Darwin relies on the "principle of selection." It is true that as eras succeed each other in the chronology of the rocks, we meet with distinct classes of organic remains. There was an age of trilobites, an age of conifers and palms, an age of reptiles, an age of huge mammalia, and the last of the series is man. But it is one thing to find that organic forms have succeeded each other, and another to prove that the last are the lineal descendants of the first; that not only species but orders have arisen by a process of development from the forms which preceded them; and this must be shown to render any hypothesis of organic progression tenable. The Phœnix is an emblem of Nature only in the poetic sense. There is an incessant soaring of life from the tomb, but it is for fable to present us with a bird born of ashes; science knows the bird only as the product of the egg, the egg being a product of a bird, and so on for ever, as in the case of our quondam relative the goose. The earliest known fossils are soon described, and their places are easily assigned them in zoological classification. But it was a real service to this sort of inquiry when Mr. Mackie sent forth his attractive little book on those first traces of life.* We know this much, that the creatures that dwelt on the face of the earth when the Longmynd was in process of deposition, were subjected to precisely the same influences as the creatures that now haunt the meadows or sport upon the pools. In the day of the silurian, air, earth, and heaven, had much the same aspects as far as the requisites of animal life were concerned; so if there was a "struggle for existence" then, it was of a kind such as we can reason upon from present experiences, without fear of going wrong. If these were the first forms of life on the globe, then we find nothing to support the hypothesis of improvement by variation, or development by initial impulse, for they are all of them far advanced beyond the imaginary nucleus, and are creatures of a higher organization than the hypothesis requires, so high, at all events, as to be fatal to it at its starting-point. Worm-tracks and worm-burrows are records of annelids; the trilobites are far removed from any primordial cell; the palæochorda and chondrites are forms of algæ that carry us back as far as we choose to go by the law of like produces like; sertularia do not grow out of sea-froth by any aggregation of self-vitalized atoms. But grant that the ages precedent to the Cambrian and Silurian have left us no reliable records, yet here are representatives of "*four out of five* of the great divisions of the animal kingdom," and there are at least materials enough to start with for any number of transformations. According to Mr. Mackie's calculation of the rate of deposit of sediment, it is 3,200,000,000 of years since the silurian fauna flourished, so there is time enough, we suppose, for the changes as well. If there is not time enough, we can only say it is all you can have, for all

* "First Traces of Life on the Earth; or, The Fossils of the Bottom Rocks." By S. J. Mackie, F.G.S., F.S.A., etc. Groombridge and Sons.

other fossils are less ancient than they. If the hypothesis be good, there will from this point be an unbroken series of developments, each succeeding one higher than the last in the scale of organization, so as to form an inclined plane, or an inverted pyramid. This is inevitably necessary. In the coal-beds, where we find remains of the most ancient terrestrial flora, conifers abound, and palms were not uncommon. According to the transmutation hypothesis, we could scarcely have expected to find anything higher than ferns there. In the secondary, from the triassic to the Purbeck gymnosperms predominate, but with these are associated some monocotyledons of species inferior to no phænogamous (flowering) plants in the complexity of their organs. From the chalk to the uppermost tertiary all the principal classes of living plants occur. During this vast lapse of time four or five complete changes of species took place, yet no step whatever was made in advance by the addition of more highly organized plants. The lower silurian contains examples of radiata, articulata, and mollusca, with indications of fish; the upper silurian contains cestraciont sharks, "than which no ichthyic type is more elevated." In the Permian there are saurians of as high a grade as any now existing. A land-shell has been found by Sir Charles Lyall and Dr. Dawson in the coal measures of Nova Scotia. The fish and reptiles of the secondary rocks are as fully developed in their organization as those now living. We have yet to learn whether, in the secondary periods, there was a scarcity of mammalia. The lower, middle, and upper eocene, the miocene, and the pliocene present species of mammalia as highly organized as any now living, so that during five or more changes in this the highest class of vertebrates, not a single step was made in advance. Geological proofs that the human species was created after the zoological changes above enumerated, are very strong. It even appears that man came later on the earth than the larger proportion of animals and plants which are now his contemporaries.*

Dr. Dawson has an able summary of the order of organic forms in the concluding section of his masterly work on the Biblical Cosmogony,† in which he insists on the advanced character of the lacertian reptiles of the mesozoic period—the megalosaurus, iguanodon, pterodactyle, cetiosaurus, ichthysaurus, etc.: "These creatures actually filled the offices now occupied by the mammals, and though lacertian in their affinities, they must have had circulatory, respiratory, and nervous systems far in advance of any modern reptiles, even of the order of loricates. A dinosaurian, walking the earth with elephantine tread, or a pterodactyle, cleaving the air with rapid wings, must necessarily have enjoyed a far more perfect circulation and respiration than the highest living reptiles." (P. 329.)

Granted, because demonstrated, there has been a succession of organic forms, and that those existing are but a portion of the scheme embraced by the whole of geologic time, yet there has not been anything like a regular advance from the humblest forms to the most complex. When the fishes come in at the close of the silurian, it is not by any gentle transition from some pre-existing form, but they were in their highest development at once. The arachnides of the carboniferous series are not partially but wholly developed as such; they come in *propriæ personæ*, not first a shadow, then a half-developed approach to the type, and then the type in full completeness.

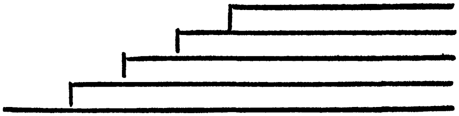
Of reptiles and birds it may be said that instead of coming by degrees and improving with time, they may rather be considered to have degenerated since the eras in which

* Sir Charles Lyall's Anniversary Address to the Geological Society, 1851.

† "Archaia; or, Studies of the Cosmogony and Natural History of the Hebrew Scriptures." By J. W. Dawson, LL.D., F.G.S. Sampson Low and Co.

they were respectively ushered in. The author of the "Vestiges" makes the best of it, and is not too careful to indicate the weak points of the argument derived from geological succession. Mr. Darwin faces the fact more boldly, and complains of the "imperfection of the geological record." Doubtless there is much to be learnt, but we must infer the unknown from the known, and the known proclaims to all who love logic and hate sophistry that species are not transmuted one into the other.

But there is even yet another way out of the difficulty, and that is in suggesting what *might be.* Where links are wanting, Mr. Darwin "sees no difficulty in supposing that such links formerly existed." When we talk of this and that being "not improbable," of a supposed condition of things as one that "may be," and the facility of "conceiving" facts which Nature does not supply, we give reins to license, and, taking advantage of that license, we here solemnly record our opinion that we know not what might happen and what might exist if only the conditions of new existences were brought about. A dog may have shaggy hair, but his blood corpuscules will be of the same character as one petted because of his silken coat. A serpent may have the rudiments of limbs, but we shall not mistake them for a quadruped in embryo so long as we can remember what are the characteristics of serpent vertebræ. Food, climate, interbreeding may change the external aspects of animals, but the tests of species will be found in their osteological structure, in the arrangement of the teeth, and in other marks that never change and cannot be obliterated. The progress of organization in time has not been by an inclined plane as here represented, but at each ascent in the scale the forms ushered in have had their fullest and highest development at once, and the order must be represented by a series of steps.



We shall rejoice still in the accumulation of knowledge, and may gain many hints of analogy and relationship of types from these attempts to assign to Nature a power which lies above and beyond. When Mr. Gosse has laboured by prochronic tests to show that we cannot certainly say that fossil forms have ever lived at all, he admits that the study of geology, as a science, is in no way interfered with. We who believe that the sedimentary strata are the graveyards of the past, and that every scrap of fossil was once the depository of life, have no occasion to pause in our inquiries because of visionary schemes intended to unsettle the very foundations of experiment and inquiry. For the present we must evidently be content with the old lesson, taught alike by science and revelation, that organic forms were created "after their kind," or, as Dr. Dawson reads it, "species by species."

SHIRLEY HIBBERD.

EXTERNAL CHARACTERISTICS OF THE DESMIDIACEÆ.

FROM Ralfs's admirable monograph we learn the best method of obtaining many species of *Staurastrum, Pediastrum,* and others, which usually form a greenish or dirty cloud upon the stems and the leaves of thread-shaped or tape-shaped aquatic plants, and which require more care in their collection than was necessary for the specimens mentioned in our first article. When desmids grow in this incoherent state, the slightest touch will break up the whole mass and disperse it through the water. To secure them, pass your hand very gently into the water and beneath the cloud, with the palm upwards and the fingers apart, so that the leaves or stem of the invested plant may lie between them and as near the palm as possible; then close the fingers, and keeping the hand in the same position, but hollow, draw it cautiously towards the surface, when, if the plant has been allowed to slip easily, and with an even movement, through the fingers, the Desmidiaceæ thus brushed off, will be found lying in the palm. The greatest difficulty is in withdrawing the hand from the surface of the water, and probably but little will be retained at first; practice, however, will soon render the operation easy and successful. The contents of the hand should be transferred at once either to a bottle, or, in case much water has been taken up, into the box, which must be close at hand. When this is full, it can be emptied on the linen as before; but in this case the linen should be pressed gently, and a portion only of the water expelled, the remainder being poured into the bottle, and the process repeated as often as necessary. Sporangia are collected more frequently by the last than by the preceding methods.

What is the use and purpose of the Desmidiaceæ in the world's economy? Doubtless, in common with other aquatic vegetables, they tend to preserve the purity of the water in which they live; moreover, they would act as purifying agents *before* other and larger water-weeds had had time to be disseminated, grown, and established. They also serve as pasture for the bivalve molluscs which inhabit fresh waters, and thus furnish a fundamental and important stave in the grand ladder of life. They supply food to numerous creatures who are themselves destined to be eaten by others, who are to be devoured in turn, till the mass of the series of victims engulphed shall constitute a fish or a fowl worthy to appear on the table of the universal eater, Man.

But to man, who is gifted with a reasoning soul, the lower tribes of organized life are useful for higher purposes than the laying the first foundation of a portion of a meal. Their study has a peculiar claim on our attention, on account of the light which it reflects on the ultimate organization of living bodies in general. The reader is probably aware that all living structures, both animal and vegetable, are built up of single cells; physiologists zealously investigate the development of these cells, because it is desirable to understand thoroughly the component atoms of organization before we attempt to explain its more complicated arrangements. Now, for the attainment of this important object, the desmids furnish the most valuable assistance. Their frond mostly consists of a single cell, which, although more complex than cells in general, enables us to trace its own history with ease and certainty, and reveals to us that of still simpler forms.

But there are moral uses as well as intellectual ones, and it will be no slight service to be rendered by a tiny plant, if it humbles our self-sufficiency by demonstrating that what the All-Wise did not disdain to create is not unworthy of human notice. In the minute Desmidiaceæ, so long concealed from the unassisted eye, we are at length enabled to recognize objects as carefully organized as the bulky elephant or the majestic oak, and as happily adapted to their position in nature; it is impossible to avoid being thence impressed by this fresh evidence of an Almighty Creator, whose benevolent design, whose divine skill and power, are as perfectly displayed in the most unsuspected as in the grandest and most obvious of his works.

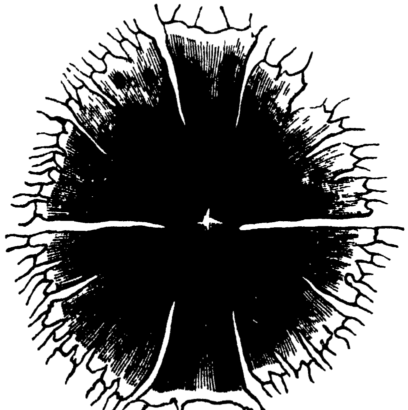
Moreover, there are the artistic uses of created things. They charm us by their beauty, they refine our minds by the admiration they excite, and they suggest themselves as patterns for imitation, enriching us with additional elements of ornamentation, applicable both to our homes and our persons. It is impossible to look at the Desmidiaceæ without regarding them as models for the jeweller's and the glassworker's art especially. The filamentous species suggest

Didymoprium Borreri (Filamentous Desmid).

lovely designs either for enamelled chains or for glass stems or rods. Examples: *Didymoprium Grevillii* and *Borreri*, *Sphæro-*

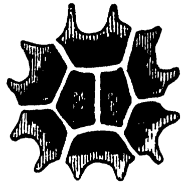
Sphærozosma excavatum.

zosma excavatum, and *Aptogonum desmidium*. The end view of single joints of these gives an object of great elegance and originality. For brooches which might become

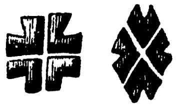


Micrasterias fimbriata.

the rage, and make the fortune of their adopter—*inventor* he would hardly dare to style himself—I would propose the inspection of ***Micrasterias denticulata, rotata, radiosa, truncata, furcata,*** and ***Crux Melitensis***, of *Tetmemorus granulata;* of ***Penium margaritaceum, digitus,*** and ***interruptum.*** The genus *Closterium* furnishes crescent-shaped brooches in abundance. The material of these might be grass-green enamel and silver. *Pediastrum* gives designs for quite a

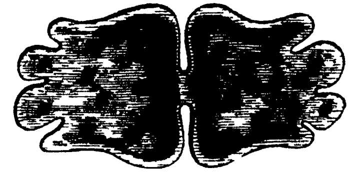


Pediastrum Napoleonis.



Pediastrum Tetras.

different character of brooch, to be executed in diamonds and emeralds for the wealthy, and in cut glass, green and white, for ladies of more moderate revenue. Novel clasps for bracelets and the like are to be copied from



Euastrum crassum (Desmid with isolated frond).

Euastrum verrucosum, crassum, ***oblongum,*** *pinnatum, insigne,* and *elegans,* besides valuable hints afforded by the genera *Cosmarium* and *Xanthidium*. The colour of these native gems (a bright grass or emerald green of purest ray serene, quite different to the sea-green hue of the aqua-marine stone), sits well on a robe of white, adorned or unadorned with artificial flowers; it also mixes brilliantly with scarlet, interspersed, for instance, with coral ornaments. It stands out well in sufficient relief either on green of the same tint but of a deeper shade than itself, or on black, affording thus a considerable range of permutation and combination to suit the differences of complexion, station, and age. As far as can be learned from coloured engravings, a very good idea of the appearance of Desmidiaceæ may be gathered from the illustrations to Mr. Ralfs's very complete and learned work—without the aid of which work this article could not have been written. But it is most desirable to inspect the objects themselves. No drawing can effectually render their beauty and brightness—I had almost said their luminosity. It is an advantage that they may be satisfactorily beheld with an instrument of moderate price and power. For the Desmidiaceæ, high powers are quite unnecessary; since they serve only to show debatable and inconclusive details (such as the occasional circulation in certain parts of certain *Closteria*), or, what is worse, they tempt young observers to fancy they see things which do not exist; for instance, the protruding organs or feet both Ralfs and the Micrographic Dictionary give receipts for preservative liquids of considerable efficacy, and specimens of several species are to be had of the dealers in microscopic preparations. Even if the term of their freshness prove short, they will serve, at least during that time, the most urgent requirements of the student and the draughtsman. But without any preparation at all, the Desmidiaceæ will remain for a long while unaltered in the bottles in which they were originally collected. When carried home the bottles will apparently contain only foul water; but if it remain undisturbed for a few hours, the Desmidiaceæ will sink to the bottom, and most of the water may then be poured off. A little fresh water should be added occasionally, to replace what has been drawn off, and the bottle exposed to the light of the sun. In this way, specimens

Closterium Ehrenbergii

with which Ehrenberg's vivid imagination endowed these same extraordinary *Closteria*. There is a general impression that microscopic preparations of Desmidiaceæ will not retain their colour permanently; in which case their beauty would be gone, like that of the flower which is cut and withered. Still of *Euastrum insigne* have been kept with their fronds in as good condition as when they were first gathered five months previously. *Closteria*, placed on a window-sill inside the window, will keep equally well for at least as long a period.

E. S. D.

CHEMICAL SOURCES OF LIGHT AND HEAT.

SINCE the discovery by Cavendish of the composition of water, there has probably been scarcely a tyro in chemistry who, on first becoming acquainted with that discovery, did not feel his bosom glow with an ardent desire to immortalise himself by making some practical application of it to the purposes of heating and lighting.

Water—so cheap and abundant in all habitable places—composed of two gases, one highly inflammable, and the other a vigorous supporter of combustion—you have only to separate them, and water becomes the source of fuel for your fires, and of oil for your lamps. Thus the young enthusiast dreams on, and before him rise visions of blazing hearths and cheerfully-lighted rooms, of streets glittering with stars, and whole towns illuminated with artificial suns, till at length he is aroused—as indeed a good many of us are aroused from the most delicious of our day-dreams—by the sordid question of cost.

In fact, it is this question of cost which has stood in the way of most practical applications of pure hydrogen as obtained by the decomposition of water; and, till very lately, the only form in which hydrogen has been used is that of the carburet of hydrogen obtained from coal. And here it is important to remember, that the mixture of carbon with the gas is so far from being a disadvantage, that it owes nearly the whole of its illuminating power thereto. Pure hydrogen, as is well known, burns with a very dull pale flame, although the heat it gives out is most intense. This consideration is sufficient to show that even though an expeditious method of obtaining gas from water were contrived, the carburetted hydrogen at present in use would not be displaced, unless the pure hydrogen could be mixed with, or applied to some substance to increase its illuminating power, with less trouble and cost than are required to extract the carburet from coal. Hence it is that, although numerous patents have been taken out in this country and in France for the utilization of hydrogen for the purposes of warming and lighting, none of them have ever succeeded. Bachhoffner's Polytechnic Fire has most likely been seen by all who have visited the Polytechnic Institution during the last few years; this was formed by merely throwing jets of burning hydrogen upon fragments of platinum foil, when the heat of the flame rendered the platinum incandescent, and the incandescence of the platinum afforded light, and thus a cheerful fire was produced. But in this, as in all other cases, the expense of the hydrogen prevented its general adoption.

It would appear, however, that M. Gillard has advanced the process a stage, inasmuch as he has lighted up the city of Narbonne with this gas, and is under contract to supply the public lights of that city for the next three years. These lights are about five hundred in number, and will therefore afford a fair test of the efficiency of his method, of which the following is an outline:—The water is first converted into steam, and conveyed from the boiler, by means of pipes, into a second series of pipes, raised to a red heat. Here the steam becomes exceedingly rare, and is ready for decomposition, which is effected by passing it over and among fragments of burning charcoal, when the oxygen immediately combines with the charcoal, forming carbonic acid, while the hydrogen is set free. The two gases, however, are as yet mixed—mechanically, not chemically—and the carbonic acid has to be removed by passing through an apparatus called a purifier, out of which the hydrogen escapes in a state fit for use. For heating purposes, it is only necessary to use a common argand-burner, with somewhat smaller orifices than is usual with other gas. For lighting, the burner is covered with a kind of cage, made of platinum wire, which becomes white hot immediately the gas is lighted, and gives out a steady but intensely brilliant light. From this it will be seen that where wood and water are abundant, and coal scarce, the method of M. Gillard may be advantageously applied, and the gas, no doubt, will prove, as he asserts, cheaper than that from coal. But in the neighbourhood of a rich coal-field, we imagine, it will be far otherwise.

RICHARD BITHELL.

METEOROLOGY OF JANUARY.

FROM OBSERVATIONS AT HIGHFIELD HOUSE OBSERVATORY.

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Year.	Mean Temperature of the Air. Degrees.	Mean Temperature of the Dew Point. Degrees.	Mean Pressure of the Air. Inches.	Mean Amount of Cloud. (0—10).	Number of Rainy Days.
1846	43·4	—	29·575	8·1	13
1847	34·6	32·3	29·701	7·8	16
1848	34·9	32·2	29·858	7·5	23
1849	38·6	36·5	29·652	7·0	12
1850	32·1	30·0	29·851	7·6	10
1851	41·1	37·3	29·573	7·6	20
1852	39·4	35·2	29·543	6·2	23
1853	40·0	36·5	29·541	6·9	27
1854	37·0	33·6	29·575	7·1	19
1855	36·1	32·6	30·007	8·6	16
1856	37·6	34·6	29·441	6·3	18
1857	35·9	32·7	29·594	7·8	16
1858	37·5	33·0	30·108	6·9	6
1859	39·7	35·6	29·951	7·3	12
1860	37·4	33·6	29·435	7·2	21
Mean	37·7	34·0	29·698	7·3	17

The mean temperature of the last fifteen years, for January, is 37·7, the range in the mean temperature being from 32·1° in 1850 to 43·4° in 1846—a difference of 11·3°. The lowest means occurred in the years 1847, 1848, and 1850; and the highest in 1846, 1851, 1852, 1853, and 1859.

The mean temperature of the dew-point of the last fourteen years, for January, is 34·0°, the range being from 30·0° in 1850 to 37·3° in 1851—a difference of 7·3°; the lowest means occurring in 1847, 1848, 1850, 1855, and 1857; and the highest in 1849, 1851, and 1853. The temperature of the dew-point was in 1858 as much as 4·5° below that of the temperature of the air, and in 1849 and 1850 as little as 2·1°; the mean difference being 3·7°.

The mean pressure of the last fifteen years, for January, is 29·698 inches at the height of 174 feet above the mean sea-level, ranging between 29·435 inches in 1860, and 30·108 inches in 1858—a difference of 0·673 of an inch (or nearly seven-tenths of an inch). To reduce these readings to the mean sea-level, it is necessary to add 0·193 of an inch, when the mean temperature is as low as 32·1°, as in 1850, and 0·189 of an inch when it is as high as 43·4°, as in 1846. On applying this correction, the mean pressure, reduced to the sea-level for January of the past fifteen years, is 29·889 inches.

The mean amount of cloud for January of the past fifteen years is 7·3 (or three-fourths of the sky loaded with cloud); the amount ranging between 6·2 as in 1852, and 8·6 as in 1855—a difference of 2·4, or a fourth of the whole sky.

The mean number of rainy days for January of the past fifteen years is 17, ranging between 6 in 1858 and 27 in 1853—a difference of 21 days. The years of but little rain are 1846, 1849, 1850, 1858, and 1859, and of much rain, 1848, 1852, and 1853.

January is usually the most severe month in the year.

E. J. LOWE.

ASTRONOMICAL OBSERVATIONS FOR JANUARY, 1861.

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THE Sun is in Capricornus, passing into Aquarius on the 20th. He was at his least distance from the earth on December 31st. He rises in London on the 1st at 8h. 8m., on the 5th at 8h. 7m., on 10th at 8h. 5m., on 17th at 8h. 0m., on 25th at 7h. 51m., and on 31st at 7h. 43m.; setting on the 1st at 4h. 0m., on 10th at 4h. 11m., on 20th at 4h. 27m., and on 31st at 4h. 46m.

The time the Sun is above the horizon in London is on the 1st 7h. 52m., on the 10th 8h. 6m., on the 20th 8h. 30m., and on the 31st 9h. 3m. (or 1h. 11m. longer than on the 1st).

The Sun rises at Edinburgh on the 5th at 8h. 33m., on the 16th at 8h. 24m., and on the 29th at 8h. 4m., and sets on the 2nd at 3h. 3m., and on the 27th at 4h. 20m.

The Sun rises in Dublin on the 7th at 8h 18m., on the 15th at 8h. 12m., and on the 28th at 7h. 56m.; and sets on the 4th at 3h. 52m., and on the 26th at 4h. 28m.

Day breaks on the 3rd at 6h. 2m., on the 12th at 6h. 1m., and on the 23rd at 5h. 53m.

Twilight ends on the 4th at 6h. 8m., on the 12th at 6h. 15m.; and on the 27th at 6h. 37m.

Length of day in Edinburgh on the 3rd, 7h. 2m.; on the 23rd, 7h. 57m.

Length of day in Dublin on the 5th, 7h. 34m.; on the 29th, 8h. 39m.

Increase of day on the 9th, in London, 17m.; on the 7th, in Edinburgh, 18m; on the 15th, in Dublin, 32m; in London, on the 24th, 54m.

The Sun is on the meridian on the 1st at 12h. 3m. 58s.; on the 11th at 12h. 8m. 20s.; on the 21st at 12h. 11m. 42s.; and on the 31st at 12h. 13m. 47s.

The Equation of Time on the 1st is 3m. 58s.; on the 11th 8m. 20s.; on the 21st, 11m. 42s.; and on the 31st, 13m. 47s.

The Moon is new on the 11th at 3h. 27m. a.m.

Full Moon on the 26th at 5h. 7m. p.m.

She is nearest to the Earth on the 2nd and 29th, and at her greatest distance on the 17th.

Mercury is in Ophiuchus at the beginning, and passes into Capricornus at the end of the month. He is unfavourably situated for observation, rising on the 1st at 6h. 35m. a.m., on the 16th at 7h. 40m. a.m., and on the 26th at 7h. 55m. a.m.; setting on the 1st at 2h. 46m. p.m., on the 16th at 3h. 20m. p.m., and on the 26th at 4h. 8m. p.m.

Venus is in Scorpio at the beginning, and in Sagittarius at the end of the month. She is unfavourably situated for observation. Rising on the 1st at 5h. 34m. a.m., on the 16th at 6h. 10m., and on the 26th at 6h.

25m.; setting on the 1st at 2h. 0m. a.m., on the 16th at 2h. 6m., and on the 26th at 2h. 21m. a.m.

Mars is in Pisces. Rising on the 1st at 11h. 10m. a.m., on the 16th at 10h. 28m. a.m., and on the 26th at 9h. 58m. a.m.; setting on the 1st at 11h. 5m. p.m., and on the 26th at 11h. 4m. p.m.

Jupiter is a fine object in the constellation Leo, and near the star Regulus. Rising on the 1st at 7h. 55m. p.m., on the 16th at 6h. 48m. p.m., and on the 26th at 6h. 2m. p.m.; setting on the 1st at 10h. 26m. a.m., on the 16th at 9h. 23m. p.m., and on the 26th at 8h. 45m. a.m.

Saturn is in Leo. Rising on the 1st at 9h. 7m. p.m., on the 16th at 8h. 4m. p.m., and on the 26th at 7h. 22m. p.m.; setting on the 1st at 10h. 55m. a.m., on the 16th at 9h. 56m. a.m., and on the 26th at 9h. 16m. a.m.

Uranus is in Taurus, and favourably situated for observation. Rising on the 1st at 1h. 38m p.m, on the 16th at 12h. 38m. a.m., and on the 26th at 11h. 58m. a.m.; setting on the 1st at 5h. 50m. a.m., on the 16th at 4h. 50m. a.m, and on the 26th at 4h. 10m. a.m.

There is an annular eclipse of the Sun on the 11th, which is invisible in England. It is central in Australia.

Eclipses of Jupiter's Satellites:—On the 2nd, at 9h. 44m. 2s. p.m., 1st moon disappears. On the 9th, at 11h. 37m. 18s. p.m., 1st moon disappears. On the 17th, at 1h. 30m. 39s. a.m., 1st moon disappears. On the 18th, at 7h. 59m. 2s. p.m., the 1st moon disappears. On the 18th, at 8h. 12m. 6s. p.m., 2nd moon disappears. On the 21st, at 2h. 6m. 50s. a.m., 4th moon disappears. On the 25th, at 9h. 52m. 31s. p.m, 1st moon disappears. On the 27th, at 7h. 55m. 49s. p.m., 3rd moon disappears.

Occultations of Stars by the Moon:—On the 13th, λ Capricorni (5½ magnitude) disappears at 4h. 46m. p.m., and reappears at 5h. 35m. p.m.

Algol will in the evening arrive at its minimum brightness on the 9th at 10h. 23m., on the 12th at 7h. 13m. p.m., and on the 29th at 1h. 8m. a.m.

Stars on the Meridian.—On the 2nd, α Arietis souths at 7h. 9m. 47s. p.m. On the 4th, α Ceti souths at 7h. 57m. 26s. p.m. On the 5th, Pleiades souths at 8h. 37m. 36s. p.m. On the 10th, Aldebaran souths at 9h. 6m. 32s. p.m. On the 15th, Capella souths at 9h. 25m. 16s. p.m. On the 16th, β Tauri souths at 9h. 32m. 22s. p.m. On the 17th, α Orionis souths at 9h. 58m. 30s. p.m. On the 19th, γ Geminorum souths at 10h. 32m. 33s. p.m. On the 28th, Procyon souths at 10h. 59m. 20s. p.m.

MAGNETIC ELEMENTS FOR LONDON.

Inclination, or Dip of the Needle	. .	68° 18′ N.
Declination, or Variation of the Compass		21° 35′ W.
Total Force	=	10° 30′
Declination at Dover	about	20° 58′ W.
„ at Hull	„	21° 55′ W.
„ at Newcastle	„	22° 50′ W.
„ at Liverpool	„	23° 5′ W.
„ at Edinburgh	„	23° 40′ W.
„ at Dublin	„	24° 0′ W.

E. J. Lowe.

THE MICROSCOPIC OBSERVER. JANUARY.

Snow.—Much has been written on the various beautiful forms of snow crystals, but observers seldom realize the full amount of interest they are capable of furnishing, on account of the fugitive nature of the objects. To observe the crystals is a simple matter enough, and it must be done with haste, and yet with precision and care. The crystals are generally rhomboid or hexagonal, among which are elementary stellate forms, in which striking resemblances may be traced to the spiculæ of sponges.

Crystals may be formed *ad libitum* by wetting slides with saturated solutions of any saline substances. There is not in the whole range of microscopy any more beautiful spectacle than the formation of crystals on the field, and in the entertainment of young people a class of subjects may thus be extemporized with the smallest possible amount of preparation. Under polarized light crystals are pre-eminently beautiful.

Insect Scales may be obtained in plenty from any entomological cabinet; even the dust from the drawers will be worth examination. The scales vary in form according to their several sources. They should be viewed both in the dry state and immersed in water or oil of turpentine, by transmitted and reflected light. In the diamond beetle the brilliant colours are produced by the incidence of light upon minute scales. The scales labelled *Lepisma saccharina*, which are commonly used as test objects, are furnished by an insect of the order *Thysanura*. It is apterous, has a tapering, flattened body, and the abdomen terminates in three filaments. Its usual habitat is the store-room and pantry, where it runs about at night with great activity. The scales are oblong ovate, regularly marked with longitudinal striæ, and serrated round the broadest end. The common spring-tail, *Podura plumbea*, furnishes scales which are used as test objects. These are oblong, and marked all over in the most regular manner with notes of admiration, !, wanting the dot at the base. To catch the spring-tails, the best trap is a sheet of paper with a little flour sprinkled on it, and laid in their haunts. Among the *Lepidoptera* the scales of *Tinea* are specially worthy of attention.

NEW COMET.

A new comet, No. IV. of 1860, was discovered by M. Tempel, at the Observatory, Marseilles, on Tuesday, October 23.

The following observations were made:—

	M.M.T.	R.A.	Decl.
Oct. 23.	16h. 30m. ..	10h 4′ 42″ ..	28° 27′
„ 24.	15h. 6m. ..	10h 5′ 6″ ..	29° 52′

G. F. Chambers.

THE NEW PLANETS.

THE following are the elements of Chacomac's new planet No. (60), calculated by Mr. Ellis, of the Royal Observatory, Greenwich :—

M.A.	15° 51′	
λ	not given.	
π	337° 51′	mean equinox,
Ω	167° 8′	Jan. 0, 1860
ι	6° 35′	
ϕ	11° 19′ ∴	
	$\epsilon = 0{\cdot}19623$	
μ	843·75″	
a	2·6053	
t	4·205 years	

Förster's new planet, No. (61), has been named *Erato.* The following are its elements, calculated by Oeltzen :—

M.A.	16° 24′	
λ	13° 44′	
π	30° 9′	mean equinox,
Ω	126° 26′	Jan 1, 1860
ι	2° 11′	
ϕ	10° 2′ ∴	
	$\epsilon = 0{\cdot}17433$	
μ	646·109″	
a	3·1120	
t	5·492 years	

Notwithstanding the confusion which the accounts given in the French scientific journals have caused, the question of precedency must clearly be settled as follows :—

Goldschmidt's planet	dis	Sept 9 ..	No (59)
Chacomac's	.	Sept 12 .	No (60).
Forster's	.. ,	Sept 14 ..	No (61).
Ferguson's	.. .	Sept 14 ..	No (62)

The Paris journals *Le Cosmos* and *L'Institut* persist in affixing (62) to Dr. Forster's planet Erato Both it and Ferguson's were discovered on September 14, but the former *must* have been seen first. The difference in longitude between Berlin and Washington is 5h. Erato was detected at 13h. 17m Berlin M.T., corresponding to 7h. 17m. Washington M.T. at which hour, in the middle of September, it would be full twilight.

We deem it necessary to give this explanation, to render the discrepancies of the newspapers clear to our readers.

No. (59), Danae, calculated by Luther —

λ	345° 41′	
π	340° 8′	mean equinox,
Ω	334° 18′	1860, 0
ι	18° 17′	
ϵ	0·16308	
μ	691·58″	
Period	5·181 years	
–	2·9746	

No. (61), Titania, calculated by Ferguson :—

λ	355° 34′	
π	158° 5′	mean equinox,
Ω	187° 12′	Oct. 1, 1860
ι	4° 41′	
ϵ	0·19804	
μ	1024·15″	
Period	3·465 years	
a	2·2896	

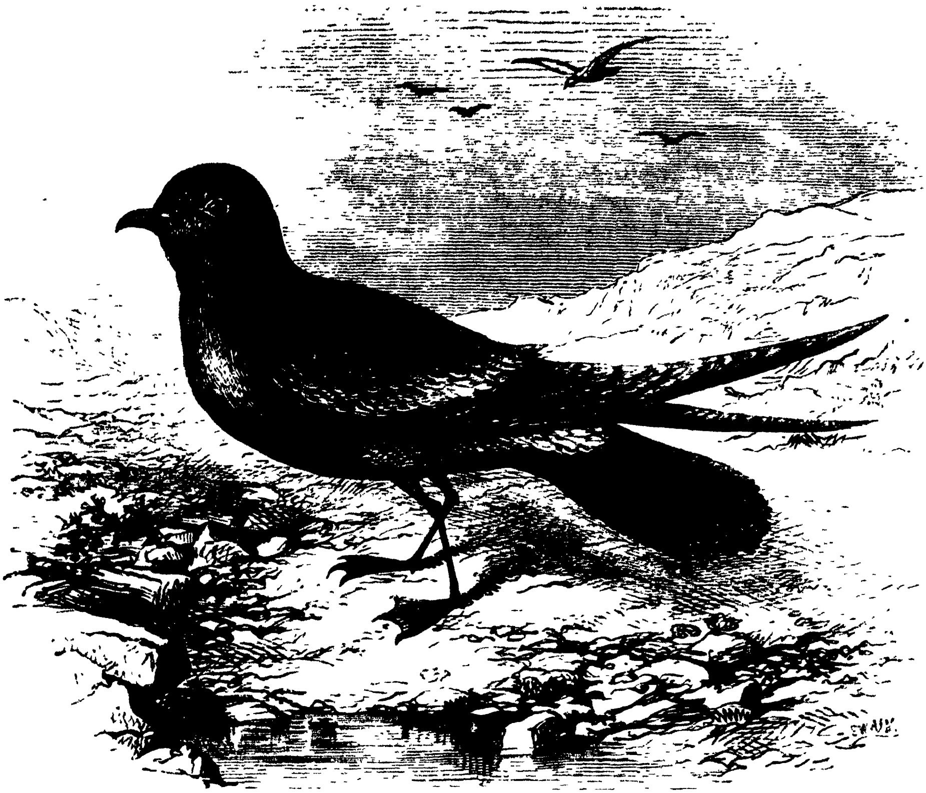
November 21, 1860. G. F. CHAMBERS.

Mr. Noteworthy's Corner.

THE FAUNA OF GUERNSEY AND HERM.—While admiring the instructive and pleasing style in which Mr. Liefchild has presented this subject to your readers, I hope he will excuse my calling his attention to the "Annals of Natural History" (especially the Nos. for August, 1858, and January and February, 1859), in which all the recent additions to the conchology of the Channel Isles have been recorded; including *Solecurtus candidus, Triton nodiferus,* and other species, which are enumerated in Dr. Locke's list. I shall be happy to show him at any time one of the specimens of *Triton nodiferus,* which were taken alive at Guernsey, or any of the other species above referred to.—J G E.

PROGRESS OF PHOTOGRAPHY.—By the same post Mr Noteworthy received two evidences of Progress in Photography, one was a proof impression of a block prepared for surface-printing without any aid from the graver, by Herr Paul Pretsch's process. This is in effect an application of photography in connection with the electrotype to the production of illustrations for books a sort of engraving by photography, or the conversion by chemical agency, of a photograph into a block. As specimens have since been published in the "British Journal of Photography," and the "Photographic Journal," Mr. Noteworthy is content to let the matter pass without comment for the present. The other proof of progress was a series of photographs, taken by Mr. Dallmeyer's Triple Achromatic Lenses, quite free of distortion. Of these the Rifleman is a gem as an art production—a rare triumph, if estimated as a test of improvement in science. In this invention there are three achromatic combinations. The front and back are positive; the former 2½, the latter 3¼ in diameter. Between the two is situated an achromatic negative combination of 1¼ in diameter. For large subjects this apparatus is evidently a vast stride of improvement.

THE GYROSCOPE OR FREE REVOLVER STAND.—This is a contrivance for taking astronomical observations at sea, by supporting the telescope on a free revolver stand, so that it may remain uninfluenced by the pitching of the vessel. It is also applicable at sea to the photographic camera, for obtaining views of marine fortifications, and for taking views from a balloon.



The Stormy Petrel.

THE OCEAN WANDERERS.

"Far as the breeze can bear the billows' foam,
Survey our empire, and behold our home!"
Byron.

The mighty ship rides proudly over the waves; land is far, far away. It has been and may be weeks, nay months, ere it is re-visited; sea and sky bound the view, both alike limitless and unfathomable. The commander of that magnificent work of man paces the deck in thoughtlessness and confidence of heart,

"Whilst beneath him yawn unmeasured deeps,
That may whelm and destroy him while he sleeps."

The wind freshens, it increases to a gale, then to a storm; the waves, from billows, become mountains of water, and the spray seems to mingle the liquid and boiling mass with the tempest-driven vapour, as it discharges its torrents of rain, and shoots forth its lurid lightnings; the crash of the thunder, and the lashing of the waters, mingling in one mighty din. But where is the proud ship? Ah! where indeed? The morning rises on a calm and serene air, all is hushed, and the sea itself is regaining its placidity. Is it witnessed by those stout hearts and fearless eyes that lately looked upon it as their servant? Let eternity answer, for thither are they swept away, and the black hull that floats on the glassy surface is all that attests their once existence. Yet are there living forms, above the waters, that outlive this elemental war. Whilst unscathed the ship sped onward on her course, small dark birds, the smallest that bear a webbed foot, kept her blithe company, withal, and cheered her on her way; but long ere her inmates dreamed of the coming storm, these heaven-taught tenants of the deep knew of its approach, and hovered, as it were, for shelter beneath her very bows. Small weak creatures, which, like swallows sweeping over the green daisy-spangled meadows, skim over their own green pastures of liquid verdure. They are stormy petrels, the naturalist's *Thalassidroma pelagica*, or he that walks the waters of the main; the Mother Carey's chickens of the sailor: creatures which, weak as they are, small as they seem, and helpless, exist, subsist, nay, revel in enjoyment, where we should find nothing but a watery grave. Who does not know the mighty gull, the *Larus* of the coast, with his vast hollow wings? Yet are the petrels his tiny likenesses. Look at the oily plumes, the downy coat which wraps him o'er, and the webbed feet, the general shape, how strikingly alike, how much frailer, yet how strong; how much smaller, yet how enduring; how exquisite a miniature representative of the form so many t[illegible]is bulk. Those who go down to the [illegible]hips, and pursue their business in [illegible] waters, these men see the works of the Lord, and his wonders of the deep; and with these the little petrel is a familiar friend. Ask the most unobservant, the merest merchant-minded follower of filthy lucre, who has seen these wonders, and he will not forget this well-known little bird. He will tell you that soon as the sight of land has faded from his eyes, they have been the companions of the voyage. Through sunshine and in shade, through tropic heat and polar cold; thousands of miles from land, away on the far off trackless breakers; round the desert islet, the solitary rock, or the sweeping current, whatever phase the ocean shows, there he is gliding and swimming in the air, through and over all. What must be the endurance of those untiring wings, which fly on, on, on for days, for weeks and never seem to rest! Take him in your hand, wonder, as well you may, and confess that with Him who created this, also, nothing is impossible. And you ask where is his home? How differently do we comprehend the word! Where desolation is wildest, where the waves are fiercest, where the tempest rages oftenest, there is he to be found. Hours upon hours his unwearied wings bear him on, on, still on; and as the starlings wing their evening way along the sweeping valleys of our own dear land, so you may see these ocean wanderers flitting along the sea troughs. Cast forth from your hand the minutest object, it is never missed; that small though eagle glance has seen and followed it, and scarcely has it touched the surface than it is picked up. What, you ask, is his subsistence? Do you suppose that the illimitable bosom of the liquid way is tenantless and void? It teems with millions upon countless millions of living things. Watch the ship's track at the still hour of midnight, and see the gleams of light that dash and glisten from her sides; are these nothing? Ask the little petrel, he will tell you that here, too, has the hand of God spread forth a banquet in the wilderness. Still would you know his home? I will take you to the lone rock that juts from out the sea, where mass upon mass of stone lies piled in picturesque confusion. It is evening. Listen; do you hear a low murmuring sound rising from the earth? It is the petrel's song, and could you lay bare the secret chamber where he lies, you would see his one white egg, warm on a few blades of sea-grass, and the little owner of the subterranean mansion, without attempting to escape, would drop a tear of oil from its tiny bill, and only utter a faint cry. And this is the creature that braves weather where neither you nor your massive vessel could live an hour! There are yet other spots where the petrel tends its single egg, in each and every species (and I will tell you of many) always white. There are sandy isles untrodden by the naval foot of man, where Staffa and Iona rear their basaltic columns; there, in tiny galleries of sinuous windings, he has his home; and the rocks of Soay and of Caru-burg are peopled by these tiny sea-fowls. Sailors, as I have said, regard them as the presage of a coming storm, and therefore as birds of an ill omen, but Wilson takes their part: "As well," he says, "might they curse the midnight light-house, that, starlike, guides them on their watery way, or the buoy that warns them of the sunken rocks below, as the homeless wanderer whose manner informs them of the approach of the storm, and thereby enables them to prepare for it."*

The name of petrel is of ancient date, and speaks of water-walking, as some are said to do with outspread wings, but also, it is likely, in the sense of metaphor, as the ship—

> "Which *walks* the water like a thing of life."
> *Byron.*

Clusius likens him to the Volscian Queen, calling him the Camilla of the seas. I shall give his verses and their translation:—

> "Vel mare, per medium fluctu suspensa tumenti,
> Ferret iter, celeres nec tingeret æquore plantas."

* Quoted in Morris's "British Birds", vol. vi. p. 244

> "Now in the boundless ocean takes his way,
> Or o'er the bosom of some swelling sea
> Suspended hangs, and, gliding through the air,
> Just skims the wave, nor plants one footstep there."

Pliny also says, "They nest in the rocks, and these are they which are met with over the whole ocean. Nor do these footless birds ever cease to accompany or fly around ships, however long their voyage, however far they may be from land." (Lib. x. c. 39). He calls them *Cypseli*, or swallows, and has the notion that like the swift they are footless, that is, never use the feet, being continually on the wing. The ancient Britons, or Welsh, called him *Cas gan Longwr.*

Travellers who yet take the long voyage around the African coast to our antipodes, from time to time note various species of these birds, and are always accompanied by some. In the tempestuous neighbourhood of the Cape, the *Daption capensis* of Stephens, the *Procellaria capensis* of Linnæus, known as the Cape pigeon, is most abundant. These are but large petrels, and still, with the *Procellaria æquinoctialis*, or Edwards's great black petrel, verge towards the larger tenants of the deep sea; and as the little stormy petrels are known as "Mother Carey's chickens," so these the sailors know as "Mother Carey's geese." Then there is Wilson's petrel, first found around the Western Isles, and made an European bird by Lucian Bonaparte, Prince of Canino. This bears a striking likeness to our stormy friend, but is a larger bird; whilst Bulwer's bird is still of greater stature and entirely black.

There is yet another bird, so like our little one that he is soon confounded by the unobservant, but his tail is forked, and when carefully regarded is obviously distinct; this species is now known as Leach's petrel. If we proceed towards the polar regions, there we shall find a host of feathered friends, and never be lone if they are company. The fulmar is Linnæus's icy storm-bird, or *Pro-*

cellaria glacialis: he is a petrel, yet he is a gull; that is, a gradual link between the two. Within the Arctic circle thousands upon thousands of this species are constantly taking their wingéd way in numbers rivalling the famous passenger pigeon of America, so that even the places of all the earth less fitted (as we think) for habitation are most inhabited.

From these we pass on to those mighty birds which soar, on almost motionless wing, eternally around the southern coasts of the old world, and seem to know no limit to their way—the albatross, the wandering albatross, a vaster gull than any that we know upon these shores; but when upon the earth, so unfamiliar is he with the sight of man that he will sit motionless and make no effort to escape. Though of so vast a size and power of wing when once launched forth upon the air, he rises with the greatest difficulty, carrying usually a goodly presence, and thence called by mariners "the Cape sheep." The albatross is looked upon by seamen with the greatest superstition as a good omen, and woe betide the unlucky sportsman who shoots one. Coleridge's famous poem of the "Ancient Mariner" is founded upon this; he says.—

'At length did cross an albatross,
Through the fog it came,
As if it had been a Christian soul
We hailed it in God's name'

The bird was unthinkingly shot by the Ancient Mariner, who recounts the miseries that thereon ensued.

Though the sea is so numerously peopled I speak but now of wandering kinds, and have but one more bird that I proceed to tell of. This is the frigate pelican, or man-of-war bird, so formed for flight that he may be called purely aerial—an ocean bird, yet having feet of very small dimensions, and only webbed in part, and feathered to the toes. These organs are unfitted equally for forest or for earth, and barely capable of supporting the frame of which they are a portion. There are those who would hastily lay hold of this formation to impugn the wisdom of the universal Cause of all created things; but, when can wisdom be more clearly shown than in forming nothing uselessly? For conformity there is the organ—for nothing is formed imperfect—but all the skill, all the wondrous power of invention and execution, is ever lavished, as it should be, upon those parts which take the lead in the created life and habits. Thus, the mole has eyes, perfect as optic organs, yet so minute as to make it doubtful whether they are at all called into action; whereas the owl, who takes his prey when all besides have sought their natural rest, is endowed with powers of seeing of the greatest limit.

The dabchick, or little grebe, is almost wingless (though he can fly), and as a walker helpless; but place him in his element, the stream, then he is strong and perfect, for all his time and energies are spent there. The auks are still more striking examples of this fact, they are always swimming or diving, some of them can do naught else, can neither walk nor fly, but for the life they lead are admirably fitted. So, in every instance, observe the mode of life, and you will see the adaptation to it. But to return: The frigate pelican may be said to be all wing. These, for his size, are of vast extent—six feet from tip to tip, whereas his actual body is scarcely two, his bill and tail making up another. Rise from a level plain he cannot, but throwing himself off some projecting point, which he always chooses, he launches into mid-air. Then it is that the beauty and fitness of his form appears, as with distended throat, acting as a reservoir of air, he skims above the water. The female wants this pouch, and is distinguished from the male by having much of bluish white about her body, whereas, he is black with green reflections, with a scarlet throat. Preying chiefly on the *exocæti*, or flying-fish, he is usually found within the tropics, and like the kite, with long forked tail, performs every possible aërial evolution, the tail being capable of every conceivable change of motion. The island of Ascension is largely frequented by these birds, of which but a single kind is known to naturalists; and, like the petrels, but one white egg, produced upon the sand without a nest, perpetuates the species.

O. S. Round.

THE LIME-LIGHT.

This brilliant light was the invention of Lieutenant Drummond, and applied by him in conducting the Ordnance Survey in Ireland and Scotland in 1826. Its intensity was such, that it was proved by him to be distinctly visible at a distance of ninety-five miles. It is so purely white, that the most delicate shades of colour may be distinguished by it as correctly as by daylight; while for photographic purposes it is invaluable, as it enables the photographer to work by night as easily as by day. To what extent this light is possessed of actinic properties, or whether this apparent power is due to the total absence of colour in its composition, I will leave others to decide. I shall here only attempt to describe the best form of lime-light apparatus which is yet known to the scientific world.

The lime-light gives out but little heat, and does not in any manner vitiate or consume the oxygen of the surrounding atmosphere, hence it is just the kind of light required for crowded rooms, factories, mines, tunnels; in short, wherever it is an object to limit the natural consumption of oxygen.

As a proof of this I may state that a five-jet lamp, belonging to the Universal Lime-Light Company, which was exhibited in the Society of Arts Lecture Room, consumed thirty-six cubic feet of the combined gases in an hour, and did not increase the temperature of the room during that length of time. It gave a more pure and powerful light than their large chandelier, which was subsequently lighted, and which consumed five thousand cubic feet in the hour; the temperature of the room kept increasing, and the atmosphere was vitiated to an unbearable degree at the end of that period.

It is hardly necessary to observe that, in common with all other lights of great intensity, it may be used for signal lights, its peculiar steadiness and continuity giving it the advantage over its rival, the Electric Light.

For use at sea, or by the coast-guard in case of wreck, and in cases where life and property are at stake, cheapness is a matter of no consideration for a light of this nature; still, where cheapness is combined with utility, the lime-light has precedence over all lights, its cost being in pence where others cost pounds.

Owing to the total absence of colour, it is not only applicable to photographic purposes, but also for picture galleries, shops, etc. etc. It is found to separate the most delicate shades of colour, and, what is of more importance, it does not in the slightest degree injure the most delicate fabrics.

A single jet of the medium size is equivalent to forty argand, or eighty fish-tail gas-lights, or four hundred wax-candles; while its cost is from a halfpenny to fivepence an hour, according to the quantity of combined gases consumed, the augmentation of which increases the power of the light. For instance, twice the quantity of gas consumed per hour will give—not twice—but *four* times the amount of light.

Comparing it with the illuminating power of common gas, a single jet, consuming four cubic feet of the combined gases per hour, equals that obtained from four hundred feet of coal-gas.

The light is produced by allowing a stream of mixed gases (one part of oxygen and two parts of hydrogen) to impinge upon the surface of a piece of lime, which it immediately renders of a white heat, and in this state of incandescence we have what is known as the "lime-light" It may here be mentioned that if common coal-gas, or carburetted hydrogen, is used with oxygen for producing this light, the light will not be so white as when pure hydrogen is used and it will cause twice the quantity of oxygen to be consumed, the relative proportions of oxygen and carburetted hydrogen being equal Great and apparently insurmountable difficulties met Lieut Drummond at this stage of the discovery and it is only within the last few months that they have been overcome. The greatest of these difficulties was that when the lime was too suddenly heated it cracked and fell to pieces, or, as it is technically termed, "decrepitated," when of course the light immediately disappeared Patents have since been taken out by Mr Prosser, for vast improvements in lime-light apparatus, afterwards described, and by which these difficulties are entirely obviated

The light emitted from the ignition of the combined gases alone is very faint, but it is the hottest flame known in chemistry Nevertheless, the dimension of the required volume of flame for heating the lime is so small, as to throw out but very little heat

The present mode of lighting a "lime-light" is to allow a stream of lighted hydrogen to play upon the lime for a few moments. The flame is first of a pale yellow, and afterwards a deep red, caused by the combustion of the metal calcium in the lime; the oxygen is now turned on, and gradually regulated so as to produce the best result.

The present system of appliance for protecting the lime from decrepitating and falling away is of the simplest character.

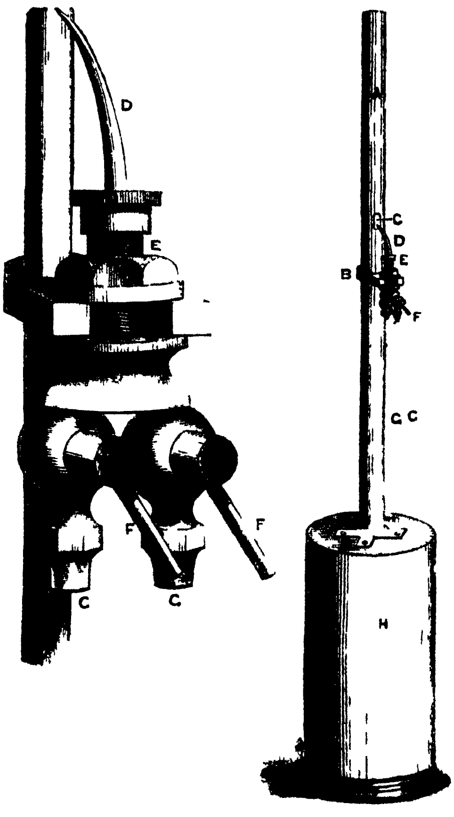


Fig. 1.—Latest form of Lamp for Lime-light

The annexed sketches (Figs 1 and 2) are front views, and Fig 3 is a side sectional view, of the same lamp, Fig. 2 differing only in form. The same letters refer to both. A is the exterior tube, containing a metal case which slides within it, and holds the lime; it is open at C, to allow of the action of the gases upon the lime in the interior tube or lime-holder. The tube A is screwed upon a box of any desired shape, which contains the clockwork, or other mechanical arrangement for raising the lime-holder about an inch or an inch and a half in an hour, and thus always keeping a fresh surface of lime in contact

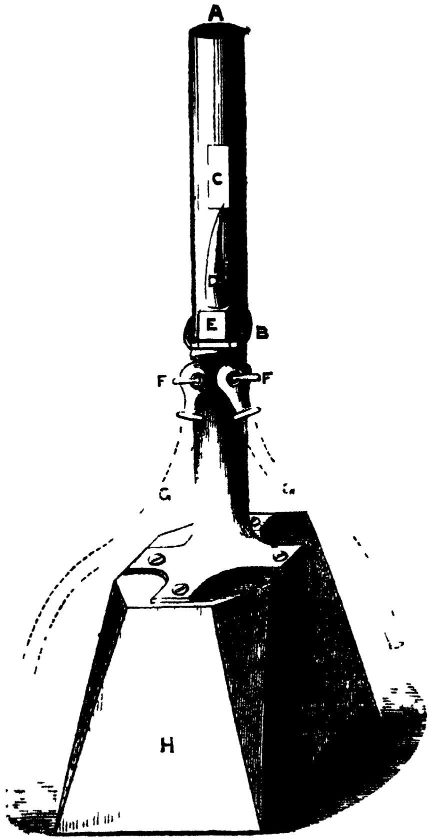


FIG. 2.

with the gases, which gives continuity and steadiness. B is a fixed stage, which holds the jet or blowpipe, the distance between which and the lime can be regulated by a screw-nut above the stage. C is an opening in the outer tube, as described. D is the blowpipe or jet; ifferent-sized jets are of course required for different-sized lights. E is a tube containing a quantity of brass-wire gauze, to prevent the regurgitation of flame; upon this the adjusting screw works, as shown in the figure; it is here the gases mix. F F, the two stopcocks for regulating the supply of each gas. G G, the supply-pipes, which may be of any material, metal or India-rubber. H, the box containing the clock-

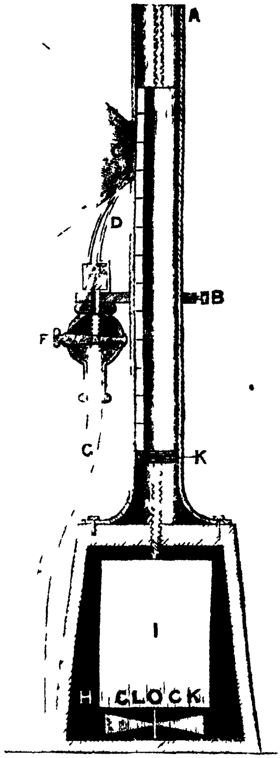


FIG. 3

work for raising the lime-holder in the tube A, by rotating an upright screw rod upon which a nut works, and rises as the screw rotates. Upon this nut, K, the lime-holder, rests. I is the clockwork, with perpendicular screw attached and fan-wheel underneath, to regulate its speed.

Fig. 4 is a transverse section of the lime-holder, which, being hollow, the screw rod passes up the centre of it at S, and pieces of lime, L, are slid into the grooves, L, until the holder is full, as shown in the interior of the tube A, Fig. 3. Each piece of lime is about two inches long, one inch wide, and half an inch thick, one side being a segment of a circle.

It will be seen, by the shape of the lime-holder, how the lime is protected. The tube A, and consequently the lime-holder (which must fit it exactly), may be made of brass, and either round, oval, square, or triangular, care being taken that neither the lime-holder, nor the nut which raises it, can take a rotatory motion from action of the screw rod.

Fig. 4.

Any number of jets may be applied to these lamps, and they may be of any size or shape. They may also be made portable, and compressed gases used, when the whole apparatus would be about the size of an ordinary moderator lamp.

As regards the manufacture of the two necessary gases, several simple means are known, and others have recently been discovered, but are not as yet made public; but both gases may be made at a cheaper rate than has ever yet been anticipated.

The lime-light is much less costly than coal-gas-light, besides the advantages it has over the latter in power, brilliancy, and penetration; and now it is rendered continuous and under complete control, it is impossible to limit the range of its useful application, and the discoveries which have just been made in producing the necessary gases will eventually make its cost as much below that of coal-gas, as the latter is cheaper than wax-candles.

It will be applied to a variety of purposes incidental to civil, military, and maritime life, in which it will accomplish the most valuable objects with ease and certainty. For railway and other signals it will be invaluable It can be used as a naked light on the mast-heads of ships in a gale of wind, for neither wind nor rain can extinguish it. This has been recently tested most satisfactorily on the landing-stage at Liverpool. Its value in case of shipwreck would be infinite.

It is possible to dispense altogether with clockwork and the rotatory vertical screw. It will be seen by the annexed figure (Fig. 5)

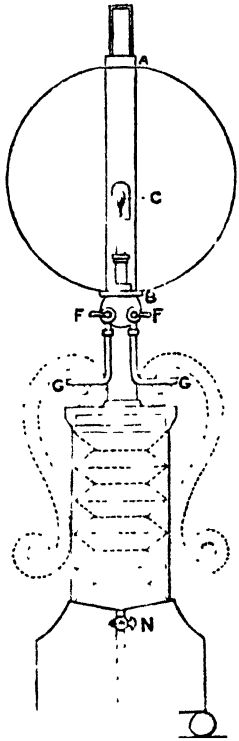


Fig. 5.

that the body of the lamp may contain a collapsing, accordion kind of bag, which is filled with air. The spring inside extends, and thus inflates it. On the upper surface is a rod, M (Fig. 6), upon which the lime-stick L rests. The air-cock, N, at the foot of the lamp (Fig. 5) being opened, the weight of the lime-stick ejects the air from the bag sufficiently slowly to allow the bag to collapse and the lime-stick to descend at the proper rate.

The simple act of removing the lime-stick to renew the lime every twelve hours or so, allows the air-bag to extend itself

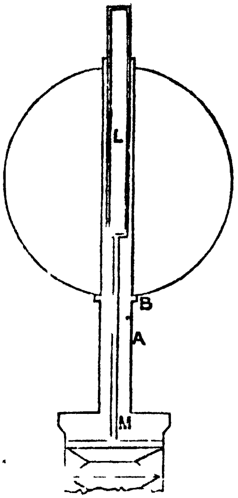


FIG. 6

by means of the spring, and again become inflated ready for use.

The portability of these lamps will be seen by the sketch.

They may be specially made for compressed gases, when, of course, the connecting gas-tubes and mechanical appliances are dispensed with. If a number of jets are required for one lamp, so as to form together a circular light, it will be seen, by the annexed figure (Fig. 7)—which is a transverse section of the lime-stick—how it is accomplished. This lime-stick is filled with lime on each of its six faces in a similar manner to the one used for the single-jet lamp. The jets in this figure are shown by dotted lines. The centre of the lime-stick is hollow. The pieces of lime are shaded. The whole slides in an

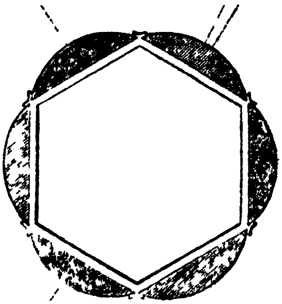


FIG. 7.

outer tube as in a single jet lamp. It is needless to mention that each "face" of lime must have its separate opening in the outer tube, and also a separate jet arranged to it.

The tube E holding the gauze is about three-quarters of an inch in diameter, and about the same depth; the gauze is punched to fit, in the same manner that gun-wads fit the barrel of a gun. A screwed cap fits over all, and tightens down the jet or blowpipe.

In conclusion, I may state that the lime-light lamp can be made of sufficient size and power to suit a lighthouse or a drawing-room, and it is believed that the time is fast approaching whe[illegible] be as generally used as coal-gas is in [illegible]ent day.

S. S. BAXTER.

THE CRETACEOUS ROCKS OF ENGLAND.

MOST people are familiar with the substance called chalk: they know that it is valuable for economical purposes; they admire the fine cliffs of Dover, the Needles, and Flamborough Head; but they know little about its real nature, composition, and organic contents; in fact, its geological history, which we now propose to lay before our readers.

The chalk itself is a white earthy limestone, more or less compact, and has been divided by geologists into three subdivisions, the uppermost being soft, with layers of flint; the middle being harder, with scarcely any flints; and the lowest being a marly chalk, termed chalk marl. This constitutes the chalk formation, which altogether attains a thickness of one thousand feet. This is usually connected with certain strata of sand, marl, and clay, which underlie it, consisting of upper greens and gault—a local term for a mass of blue clay, which divides this from the lower green or iron sand; and this triple series forms the green-sand formation, the whole of which belong to the cretaceous group. The chalk is indeed a very remarkable deposit, both from its peculiar lithological structure, which distinguishes it from all other rocks, as well as from its extensive range in most countries of Europe. The purest and best chalk used for economical purposes is white, for which both the hard and soft varieties are successfully employed. In chalk districts it is thus used with great advantage, and being close at hand, it is of course obtained at little cost. The harder beds, which always form the lower portion, are used for building, and the whole of it makes an excellent lime. The inferior divisions are usually of a dingy white colour, sometimes interspersed with green grains, and in Norfolk and Yorkshire it has a red colour also, derived from iron. In Ireland, near the Giant's Causeway, the small patch of chalk which crops [illegible] has been converted by its contact [illegible] the basalt into a very close and com[illegible]estone, and this is not a solitary [illegible] the land. One of the most striking [illegible] characteristic features of the upper beds of this formation are the layers of nodular and tabular flints interspersed through them. The lower strata contain them also, but rarely and irregularly; and the student who wishes to investigate this subject must visit the numerous quarries of upper chalk in Kent, Surrey, [illegible]tshire. The origin of these silioeous masses is difficult to account for, and it forms a very interesting and curious problem. One thing is sufficiently evident, that the sea which deposited the upper portion of the chalk contained both carbonate of lime and silex, both of which may have been derived from organic bodies; for a microscopic examination of chalk and flint shows an abundance of minute organisms, chiefly remains of chambered shells and sponges, from the decomposition of which much of the silex may have been obtained.

Thermal springs have been suggested as a probable source of the silex, but the former suggestion seems the most satisfactory. The flint itself is extensively used in the formation of roads, and makes capital stone-walls; and before the introduction of percussion-caps, it was generally employed in the manufacture of gun-flints. It is also well known that the ancients turned it to account in the fabrication of knives, axe-heads, and points of spears and arrows.

Masses of iron pyrites are found more or less disseminated throughout the chalk, of various shapes and sizes; and when picked up, as they often are on the Wiltshire and Sussex Downs, are not unfrequently treasured as thunderbolts, and are supposed to have fallen from the clouds. An equally strange idea as to the *growth* of flints seems to prevail in the minds of some persons, from the fact of their frequent occurrence on the surface of the soil, and though carefully picked up and cleared away year by year, are still found in equal profusion; and we recollect being once asked the question by a farmer whether the flints did not grow, for he was evidently sorely puzzled to account for their so constantly turning up upon any other supposition. The abundance of flint in chalk countries is, however, sufficiently remarkable, though the fact of their abundance is simply to be explained by the great amount of denudation which the beds containing them have undergone, the soft matrix being washed away, leaving the harder siliceous nodules in its place.

This wearing away of the chalk formation by currents of water, of greater or less intensity, has given rise to those numerous dells and hollows, which form a striking feature in the scenery of the North and South Downs, of which the Devil's Dyke, in Sussex, is a notable example. And a traveller over the wide and dreary tract of Salisbury Plain is often suddenly surprised by coming upon a wooded and cultivated valley, in which the pastoral villages of the plain are almost universally and picturesquely placed. These ramifying vales are also the outlets of numerous trout streams, where the geologist, if he happen also to be a fisherman, may while away an hour with a fly-rod, and study some geological phenomena at the same time. There are, however, many parts of the Down county, where water is not so abundant, and wells are often obliged to be sunk to a great depth before any can be obtained.

The general character of the chalk range in its extension in England, is that of downy undulating hills of some height, generally without trees, but sometimes well wooded, the beech growing most luxuriantly; and the escarpments of the hills often command fine and extensive views over the surrounding country. Even the wide, dreary expanse of Salisbury Plain has something novel and striking in its appearance, and the fine fresh air and the soft turf are always invigorating and enjoyable. These Downs are excellent pastures for sheep, and of late years they have been ploughed up in many places, and prepared for various agricultural purposes. The intervening valleys are always highly cultivated, and produce good and abundant crops. The chief occupation of the population inhabiting the chalk country is for the most part agricultural; but of course in a formation occupying so large an extent of surface, a vast number of people are otherwise and variously employed, though the large and more important manufactures are not found within its area.

In order to trace accurately and to understand the range and extent of this formation, our readers must refer to a geological map, when it will be seen that it may be traced from the Dorsetshire coast to Flamborough Head in Yorkshire. There is a break, however at Hunstanton Cliff, in Norfolk, which is divided from the Lincolnshire coast by the Wash, thence it rises into the Wolds of Lincolnshire and Yorkshire, terminating at Flamborough Head. From Winchester it branches off to the coast near Canterbury, and the Sussex coast at Beachy Head. It thus forms a kind of basin, surrounding in part the wealden of Kent and Sussex, the former portion being called the North, and the latter the South Downs. The Wiltshire Downs occupy the largest and the most central area of the cretaceous system. It thus appears that a large extent of surface is occupied by it in England, including many counties; but considerable as this is, it must have been at one time much greater, as a glance at the map will show, as it certainly overspread the central area between the North and South Downs, extending across the space now occupied by the London clay and crag in the Eastern counties, which would of course give it a still wider range. It is impossible to say now how much further it may have extended, but there can be no doubt that England and France were [illegible]ted, the cliff section on each opposit[illegible] exactly corresponding. Here and the[illegible] there are outlines and patches to be [illegible]at some distance from the main mass, which may be observed at Sidmouth and Chard.

We have here strong evidence of the vast amount of denudation which the chalk has undergone since its original deposition, and the quantities of chalk flints, and fragments of chalk, scattered over the surface in many parts of England, far away from the nearest chalk hills, would lead to the inference that it was once present there *in situ*. The student who wishes to examine the best sections of this formation will find them on the coast, especially in Sussex and Kent, where it forms fine ranges of cliffs, rising in places to the height of nearly 600 feet; inland it is still higher, and Inkpen Hill in Wiltshire is stated to be 1000 feet above the level of the sea. The numerous chalk pits which are opened and worked for economical purposes, in various spots, also afford good and instructive sections. Thus far we have noted many interesting and important facts relative to the history of the cretaceous series, but this would be incomplete without some detailed account of the numerous and varied fossils with which it almost everywhere abounds; and indeed we could not understand its origin without. On examining a piece of chalk with a microscope, it is found to be made up for the most part of minute organisms, broken and entire, of infusorial animalculæ and foraminifera, little animals with shelly envelopes, which performed a very important part in the actual composition of the chalk itself, and which still abound in the seas and rivers of the present day. Their structure is extremely curious and interesting, and when inclosed in flint, as they often are, they present very beautiful objects under a good microscope. So numerous are they in some places, both in cretaceous and tertiary strata, that masses of rock of vast thickness are entirely composed of them, and among the foraminifera the *Nummulite* may be especially cited as a striking example.

The chalk is particularly rich in the remains of zoophytes, especially sponges and alcyonia, and there is scarcely a flint which does not contain some traces of them, and they owe their somewhat strange and peculiar forms to various species of this class. The *Ventriculite* and *Choanite* are among the most common and striking forms, and some flints when broken open exhibit the radiating tubes of the latter in great perfection, whereby the internal structure is beautifully displayed. Branching sponges also occur both in the flint and chalk. A long pyriform zoophyte is met with in some localities, and more especially in the green sand below. There are many species of small corals, often, however, very fragmentary, scattered indiscriminately throughout the chalk, the nature of which indicates a deep sea, and not one in which coral reefs abound.

Ascending in the scale of organization, we find among the radiated animals many beautiful species of star-fish, one or two species of *Encrinites* (or stone lilies), and the pouch-shaped *Marsupite*, a free swimming *Crinoid*, peculiar to the chalk. There are also many and varied forms of *Echinoderms*, or sea-urchins, some genera of which, the *spatangus* and *ananchytes*, are generally abundant and characteristic. Scattered throughout the chalk, in greater or less abundance, are numerous bivalve and univalve shells, some of which are known only in this formation, while others previously abundant now become extinct; and one genus, the *terebratula*, so frequent in both this and the oolitic period, still exists in the present day. Now for the first time appear those curious cephalopodous molluscs, which, from the external form of the internal shell, are respectively named *Ammonite*, *Belemnite*, *Baculite*, and *Turrilite*, the two former of which swarmed in the earlier oolitic and liassic seas. The cuttle-fish of the present day belongs to this family, and they have been well called the scavengers of the deep. Remains of *Crustacea* are sometimes met with, but rarely perfect, the claws being the most frequent.

In some localities, especially in Kent and Sussex, beautiful and perfect fish have been discovered, and forty species at least are known from the pits of the latter county; the most common forms being allied to the carp, salmon, and perch. There are also certain genera of predaceous *sauroid* fishes, and the teeth of sharks are generally abundant throughout the chalk. A fine collection of fish and other chalk fossils may be seen in the British Museum, a visit to which will be of more value to the young geologist than a dry scientific description of their structure and organization.

A few fragments, chiefly bones and teeth, of marine reptiles, some of them of gigantic size, have been discovered in the cretaceous system; together with the long bones, jaws, and teeth of that singular flying saurian the *Pterodactyle*. It will be observed that the fossils above referred to are exclusively marine; and although traces of drift wood occur in the chalk, and fir cones in the green sand, they are comparatively rare, and afford hitherto the only evidence we possess of neighbouring land. It is clear, then, on the whole, that the sea which deposited the chalk abounded with life, and that it was of considerable depth. Some of the genera and most of the species are extinct, being unknown at the present day, though in general character they more nearly approached it than those of former geological epochs. Some forms became extinct at the close of the cretaceous system, some are peculiar to it, appearing for the first time, and dying out ere the tertiary period commenced. These are some of the many striking facts which geology brings to light; and while the study of the organic remains in any formation is always a source of deep interest and increasing instruction, they are chiefly of value in enabling us to determine the conditions which prevailed during the different cycles of past time, before our present continents and seas existed in the form they now occupy, and thus the geologist can read off the pages of this most ancient history, and describe with truth and accuracy the teachings of the rocks. The fossils of the chalk, from their beauty and delicate state of preservation, have always attracted attention, and have been very largely and generally collected.

Rowington Vicarage. P. B. Brodie.

THE SHELL-COLLECTOR IN LONDON.

After all that can be done, by the most ardent conchologist, in woods and fields, in lakes and rivers, on mountains and by the sea-shore, with the aid of the trawl and dredge, and by exchange with friends, it is scarcely possible to complete a collection without using that "silver net" which serves at all seasons, and is more effectual in the centre of a great city than other nets in the midst of tropical seas.

We are strongly against indiscriminate collecting and buying. Very few can make a *general* collection with success. The British Museum is supposed to contain about half the known *species* of shells; but this half requires a gallery 300 feet long for its exhibition, and the fifty glass-cases are supported by as many cabinets containing additional specimens, and suites illustrating geographical distribution. A cabinet of a dozen drawers will hold all the British shells, about 500 in number; and a similar cabinet will contain examples of all the genera and principal *sub-genera* of exotic shells, which is as much as conchologists usually require, and form the most interesting and instructive collection that can be made.

At the very outset a book is wanting, and whose shall it be? We will set forth a choice of *manuals* suited to the strength and means of every purchaser, costing from five shillings to twice five pounds, and weighing from sixteen ounces to half a hundredweight.

Sowerby (G.B.), "Conchological Manual,"

ed. 3, 8vo, 1846, 27 plates (561 figures), price £1 16*s*. coloured, 15*s*. plain.

Reeve (Lovell), "Conchologia Systematica," 4to, 1841—1843, 300 coloured plates (1500 figures), £10.

—— "Initiamenta Conchologica," 2 vols. 8vo, 1845—1860, 62 coloured plates, £2 14*s*.

Woodward (S. P.) "Manual of Mollusca," 12mo. 1851—1856, 25 plates (580 figures), and 270 woodcuts, in 3 parts, 5*s*. 6*d*.

Catlow (Agnes), "Popular Conchology," ed. 3, 12mo, 1856, price 14*s*.

Adams (H. and A.), "Genera of Recent Mollusca," 3 vols. 8vo, 1853—1858, 138 plates, £4 10*s*. plain, £9 animals coloured.

Sowerby's manual is arranged alphabetically; it has had a large sale, and is a useful book of reference, or dictionary of conchology. Lovell Reeve's ponderous quarto is a drawing-room book, with fine-coloured plates, and a rather homœopathic allowance of letter-press; whilst Miss Catlow's little volume is illustrated with woodcuts, which have the advantage of being incorporated with the text. "Our own" manual we must refer to (as people speak of children who have cost them pain and trouble) with mingled satisfaction and regret. More than seven thousand copies of it have been circulated, and it is now both out of print and out of date, for in the last ten years an amount of conchological work has been done which was altogether unprecedented; so many new shells have been described and new genera proposed; so many of the old names have been changed for better or worse; new facts of structure and history made out and recorded, that the last published manual already requires revision in every page.

"We write in sand, our *science* grows,
And, like the tide, our work o'erflows."

Nevertheless, we believe and trust that the method of arrangement and rules of nomenclature we have adopted (in accordance with the views of Forbes and Owen) will continue essentially the same.

Messrs. H. and A. Adams have availed themselves of all that their predecessors had done, and added a good deal beside. Their figures are excellent; but they have injudiciously changed the names of even the most familiar shells—changes which will never come into use, and the chief alterations they have made in the arrangement of the groups have proved to be founded in error. Like Mr. Reeve, they give lists of the species of each genus, but these are confessedly imperfect, especially the land-snails, of which more than a thousand are omitted. Mr. Damon, of Weymouth, has printed a list of *genera* in bold type, intended to be cut out and used as *headings* in cabinets of shells; and there is a catalogue of the *species* of shells, with references (printed in quarto), by Reeve and Catlow.

We will suppose the conchologist has chosen his text-book, and proceed next to speak of *localities* for purchasing shells. The prince of shell-merchants, of course (*facile princeps*), is Mr. Cuming, of 80, Gower Street, who can supply whole collections, and many costly varieties which no one else could obtain; and there is Professor Tennant, of 149, Strand, who has recent treasures, in addition to a mine of fossil-shells. But perhaps the beginner had better consult Mr. B. M. Wright, of 36, Great Russell Street, who is at once the most accessible and most experienced purveyor in this department. Mr. G. B. Sowerby, jun., has also commenced business in this locality, where his grandfather lived so many years, the most scientific shell-merchant of modern times. Mr. R. Damon, of Weymouth, is a very successful collector of British shells, and has a large store of foreign shells, too, at the service of his customers, by post.

We cannot say much in the way of direct advice about shell-buying: *experientia docet;* or, rather, experience must be bought with the shells. The greatest pleasure is afforded by obtaining new specimens frequently—a few at a time. It may be well to begin by collecting examples of the genera, leaving the *sub-genera* till afterwards. It does not much matter what species of a genus is first obtained—the one figured in the text-book is probably a good example, and the most common or easily procured. Ultimately, it will be found desirable to have several examples of the large and widely-variable genera.

With regard to price, many collectors restrict themselves to sixpence a specimen, at least when they begin; and there are few genera of which examples cannot be had for half-a-crown. At Stevens' sale-room, in Queen Street, Covent Garden, there are collections on sale almost every Friday, and sometimes large trayfuls of shells can be bought for a few shillings, the individual specimens costing less than a penny apiece. These may be good investments for the conchologist who has some knowledge, or a friend to advise; and the duplicate specimens will enable him to make exchanges with his acquaintances. It will not matter about the specimens being dirty, if the dirt will wash off; but shells are often discoloured in various ways, or bleached by exposure to the sun, corroded by parasites or the action of chemical agents, or worn by rolling in the surf of the sea-shore. Specimens with the edges broken or filed down are particularly obnoxious to eyes which delight in the contemplation of physical perfection; but sometimes it is not easy to get perfect examples, and a beginner may be glad of an inferior specimen until he can obtain better. Shells which have been taken with the animal alive are always fresher and brighter, and more translucent, than those which have lain on the sea-bed or amidst herbage after the owner's decease. These are stained or faded, and are called "dead shells." Even living sea-shells are frequently overgrown with worms (*serpulæ*) and sea-weed, but in this case their *apertures* are still bright and freshly-coloured. The incrustations on sea-shells can sometimes only be removed by the use of chloride of lime, which is also employed to deodorize them; but "overcleaning" with chloride of lime or dilute hydrochloric acid is very objectionable, and spoils the appearance of specimens. Warm water and soap, and a nail-brush, are usually all that is required.

Shells with a conspicuous or coloured *epidermis*, such as most of the land-snails, and northern sea-shells, should exhibit it; or if, as in some of the cones, there are fine colours beneath, it will be advantageous to show them in both states. Many shells also have an *operculum*—a lid which formerly collectors did not care to preserve; but now it is found to add much to the interest, and consequently to the value, of specimens, and it often affords a means of determining the family or genus of the shell.

In many instances the young condition of a shell is so different from the adult that it might be mistaken for a distinct species, or even for a member of another genus. The young cowry has a thin, sharp lip, like a *pyrula*, and the immature scorpion-shell, *pterocera*, is destitute of the expanded lip and claw-like processes which signalize it when adult. Hence some collectors endeavour to obtain three examples of each shell, exhibiting the juvenile, middle-sized, and full-grown condition.

Mr. Wright, who makes up collections of shells for beginners, charges £1 for 100 genera, £3 for 200 genera, and so on, the price increasing with the difficulty of obtaining examples of the additional genera. For 75 species of the common British shells he charges 10*s*., for 150 species £2, and a tolerably complete collection, containing 400 species, is worth £25.

Some of the British shells fetch high prices on account of their rarity, although their appearance is by no means attractive. The rude-looking bivalve called *Panopæa*

Norvegica cannot be obtained for less than three guineas; and there is an unusually good specimen, which was in the collection of Mrs. De Burgh, which was offered to the British Museum for six guineas, and declined, but afterwards realized nearly that amount. *Tellina balaustina* is a much smaller, but brightly-tinted shell, of which there is a specimen in the Museum worth three guineas. The most valuable of the univalves are some of the large whelks; it is impossible to get a specimen of *Fusus Turtoni*, even from the fishermen, for less than 30*s*., because it is only taken on the Scarborough coast, and there are always residents as well as visitors ready to buy it. A fine example would fetch three guineas in town. *Fusus Dalei* is worth from three to five guineas; *Fusus Berniciensis*, five guineas; and there are collectors who would give still more for the *Fusus fusiformis* if it could be obtained. The little *Stylifer Turtoni*, found on the backs of sea-urchins (*Echini*), nestling among their spines, would have cost a guinea ten years ago, but has recently been found in considerable numbers at Plymouth.

Mr. Damon, of Weymouth, is able to supply examples of nearly all the British shells, and he has sets of specimens from the Mediterranean, from the Arctic seas, Moluccas, Mazatlan, etc., and land-shells, also in suites, from Jamaica, India, the Sandwich Islands, and other countries.

Since the year 1825, when George Sowerby catalogued and priced the Tankerville collection, shells have much diminished in pecuniary value, and shillings will now generally go as far as guineas did then. This depreciation has chiefly affected the deep-sea shells, which have become more plentiful since the employment of the dredge has been generally introduced, and land-shells, which are mostly procured in abundance when their proper localities are understood. But some shells seem destined to be always scarce, like the orange cowry, and the *Conus gloria-maris* (Fig. 1). No doubt there are "as good fish in the sea as ever came to net," but sometimes they live in inaccessible places. The locality of *Halia Priamus* is still a secret, and it fetches a higher price now than it did thirty-five years ago; it is said to inhabit the coast of Spain, but Mr. M'Andrew never met with it there in all his researches. Shell-collectors, like the old Dutch florists, have always set apart a few genera as the special objects of their affection, to which they attach a fanciful value. These are the cones, cowries, mitres, and volutes; with a few miscellaneous species belonging to other genera, such as the thorny-oyster, wentletrap, *Carinaria*, harp, and *Rostellaria*.

Most of the stories told about the extravagant prices paid for particular shells are probably apocryphal, or grossly exaggerated. It is said that a Parisian "professor of botany" paid 6000 francs (£240) for a thorny-oyster (*Spondylus regius*), and that a Dutchman gave *an estate* for a wentletrap (*Scalaria pretiosa*, Fig. 2). *Now*, the *Scalaria* is worth

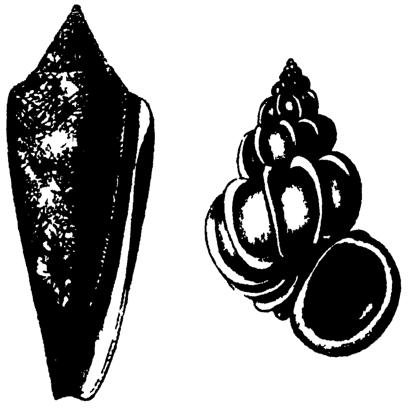


FIG. 1. *Conus gloria-maris*. FIG. 2 *Scalaria pretiosa*, ½.

from 5*s*. to 10*s*., and the finest *Spondylus* in England was purchased by Mrs. De Burgh for £5. The *Carinaria vitrea* (Fig. 3) which, according to Sowerby, once realized 100 guineas, is still worth £12 in the market, and fetched as much as £15 only a few years ago; but the value of fine specimens of this shell is enhanced by its extreme fragility. One of the orange cowries in the British Museum was purchased by Mr. Broderip, of the late Mrs. Marwe, for £30, although it has holes in it made by the natives; and *fine* specimens are still worth 10 guineas. The *Cypræa leucodon*, in the same collection, is unique, and worth £50; the *C. princeps* was valued at £60, and other examples have re-

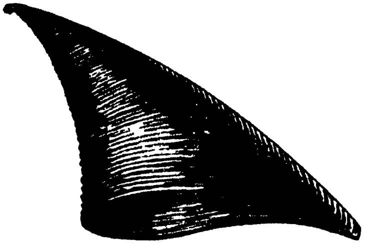


Fig. 3.—*Carinaria vitrea*, from China. One half the size of the original.

alized £40 at the Tankerville sale, and £10 at the sale of Mr. Holford's collection; Mr. Dennison, of Liverpool, has one which cost £35.

The specimen of *Cypræa guttata* (Fig. 4) in the British Museum is valued at £10; the rare little *Cypræa Barclayi*, when first brought to England, obtained £10; and *Cypræa guttata* has realized sums varying from £12 to £30, within the last ten years, and as the specimens are generally in poor condition, it is certain that fine examples would still command a high price. The cabinet of Miss Saull, of Bow-Lodge, is considered to be richer than any other in this group of shells; and the late Mr. Gaskoin, who wrote a monograph of the genus *Cypræa*, had a very extensive series, which now forms part of the magnificent collection of Mr. Lombe Taylor, of Starston.

The cones form a numerous group, more than 200 strong, and are distributed throughout the tropical seas. Individuals of many species are almost as abundant as the cowries, while a few, and those amongst the most conspicuous, are exceedingly rare. The *Conus Neptuni*, in Mr. Cuming's collection; *C. Caledonicus*, in that of the Baron Delessert; and *C. Bowini*, in the cabinet of Mr. Bowin, are considered unique. A specimen of *C. Thalassiarchus* was sold for £4 15*s*., and good specimens of *C. nobilis* (Fig. 5) are worth from £3 to £6. The "Admiral" (*C. ammiralis*) is a

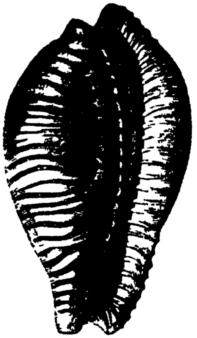


Fig. 4.—*Cypræa guttata*. Fig. 5.—*Conus nobilis*, ½.

beautiful shell, although no longer esteemed a great rarity; but *C. cedo-nulli* (Fig. 6) has maintained its fame for a century, on account of the variety of painting it exhibits, and the extreme rarity of fine examples. A specimen was sold at Mr. Harford's sale for £16. The rarest of all cones, and perhaps of all shells, is the *gloria-maris* (Fig. 1), which those old pagan Dutchmen worshipped, as did the Greeks the Paphian Venus. Perhaps it was this cone of which a Frenchman is related to have had the only specimen, *except* one belonging to Hwass, the great Dutch collector, and when this came to the hammer he outbid every rival, and then crushed it beneath his heel, exclaiming, "Now my specimen *is* the only one." Doubtless many traditions respecting the *gloria-maris* yet linger in the marts of Amsterdam; with us it is still worth ten times its weight in gold. The Museum specimen formed part of the collection of the late Mr. W. J. Broderip (the magistrate of the Thames Police Court), who gave £70 for it; and a second, in the cabinet of Mrs. De Burgh, was originally obtained from Holland for the late Mr. Norris of Bury, a veteran collector, who expressed himself highly privileged to become the possessor, even in his old age, of such a treasure, at the same price.


Fig. 6.—*Conus cedo nulli.* Fig. 7.—*Mitra Stainforthii.*

The mitres are even more numerous than the cones, and like them are denizens of the tropical seas. Many of them must be very abundant, and yet a scientific person who only invests shillings in the purchase of shells may go on for twenty years and find himself only in possession of half a dozen obscure species, and of one common and brilliantly coloured sort, the *Mitra episcopalis*. The most beautiful of the Mitras is properly called *regina;* but the rarest is *M. Stainforthii* (Fig. 7), valued at £10, of which Mrs De Burgh possesses the original example. The same lady has the only specimen in England of the equally valuable (but not equally beautiful) *M. zonata* (Fig. 8), which was brought up by the lead of a sounding-line from deep water off Nice, and described by Marryatt in the Linnean Transactions of 1817.

The volutes are large and fine shells, elegant in their form, and often remarkable for their painting and rich colour. They are tropical shells, amounting to about 100 species, and have been grouped in about half a dozen sections or sub-genera, examples of some of which will be hard to get. The *Voluta abyssicola*, supposed to be the living representative of the fossil volutes of the London clay, is only known by a unique specimen from deep water off the Cape, now in the collection of Mr. Lombe Taylor. The *V. aulica* was


Fig. 8.—*Mitra zonata.* Fig. 9.—*Voluta Junonia*, ½ Gulf of Mexico.

unique until Mr. Cuming's return, and Sowerby valued the Tankerville specimen at 10 guineas. *V. fulgetrum*, in the same col-

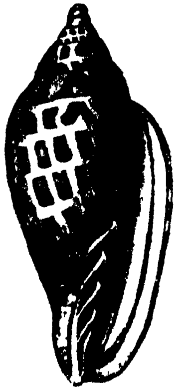



Fig. 10.—*Voluta piperata.* Fig. 11.—*Voluta reticulata*, Swan River.

lection, was priced at £31, and *V. papillosa* £21. The fine *V. Junonia* (Fig. 9), in the British Museum, is worth £40, and the less conspicuous *V. piperata* (Fig. 10), lately acquired at M. Vernède's sale, was valued at £16. The *V. reticulata* (Fig. 11), in Mr. Norris's collection, cost £30, and Mr. Dennison gave £40 for his. The same enthusiast gave £20 for the first specimen of the *Oniscia Dennisoni*, and his collection is remarkable for the number of fine and costly shells it contains.

The harps can no longer be quoted for rarity or value, although still among the most beautiful of shells. The "Many-stringed Harp" (*H. imperialis*) may be still worth several pounds. The *Rostellaria fusus* (of Linnæus), with its long and slender beak, is a shell worth £5, especially if in good condition; for although Sir E. Belcher brought home thirty or forty specimens, they were all dead shells. A fine example of another curious shell, the great *Dentalium Vernèdei*, was lately purchased by Mr. M'Andrew for £2 10*s*.

Many of the land-shells are very fine and costly, but the names of species which are worth from £1 to £3, when in good condition, are far too many to be enumerated. Novelties realize higher prices, like the *Cyclostoma De Burghæ*, which was worth £5 when first brought from Madagascar by Madame Ida Pfeiffer—poor restless soul! A few snail-shells were all she obtained in compensation for a fever, which terminated her wanderings and her life.

Few of the bivalves have been esteemed "fancy" shells, or commanded high prices, but some of the *Chamas* and *Spondyli* are very beautiful, and might well distract a Dutch or French collector. Sowerby valued the *Spondylus regius* in the Tankerville catalogue at £25; the best *Chama* at £3 3*s*.; an *Isocardia* at £8 8*s*. (!); *Ætheria elliptica* at £21 (!!); and the *Lucina Childreni*, now in the British Museum, at £10 10*s*., because it had the hinge reversed. Mr. Norris gave £20 for the *Mülleria*, an extraordinary shell to the conchologist (although most unattractive to the eye), of which the late M. D'Orbigny sent several specimens to the Museum in exchange for a fossil *Pentacrinus*.

We have still to say a few words about *cabinets*. These should be made of mahogany or oak (Edwards, of 40, High Street, Camden Town, is reputed the best maker), and the drawers should be all of the same depth, as the arrangement of shells ought not to be governed by their size; but any very large specimens can be laid on the top, or arranged in a glass case. There should be no shelves *between* the drawers, to waste the space and cause the larger shells to get set fast perpetually; but the sides of the drawers should be three-quarters of an inch lower than the front, to allow of their sliding on slips of oak screwed to the sides of the case. In London it may be desirable to cover each drawer with a sheet of gray paper, pasted to its front edge, to exclude the dust which *will* penetrate in spite of the folding-doors and accurate fittings. We wish emphatically to recommend *good* cabinets—the best that can be got; because we have seen instances where, in consequence of the cabinets being large and ugly, they were turned out of the civilized part of the house to moulder in a cellar or back kitchen. If it is worth having a cabinet at all, let it form part of the furniture of a room habitually in use, for a shell-cabinet is ruined by damp.

Lastly, in arranging the shells, some will begin with the bivalves, others with the univalves; to us it appears perfectly indifferent which method is followed. Most collectors will conform to the text-book they have chosen; but in practice, the systematic arrangement must be set aside occasionally, in order to keep entire groups of shells in the same drawer or cabinet. Some will keep their specimens loose in trays; others lay them out neatly on sheets of cotton wool, anp are perpetually in fear lest an unlucky shock should roll them from their ranks; some fix them upon tablets of mahogany covered with drab paper; others have a fancy for glass, and stick them down with liquid India-rubber, or marine glue, each being guided by personal convenience, taste, or the special object had in view. Shells take up less room in trays, and for useful purposes they are always better loose; but then the specimens are liable to be misplaced, and there is a difficulty about attaching labels so as not to conceal any essential part of the shell. Therefore in all public museums, and in the most scientific private collections, the specimens are fixed on tablets, which are papered on *both* sides, and must not be made of deal or any resinous wood. The size of the tablets must depend on the drawers or glass frames of the case; from three to four inches is a sufficient breadth to admit of a long label, with the name and locality of the specimens being pasted at the bottom of each. If the drawers are sixteen inches wide, they will allow four vertical rows of four-inch tablets, or five rows of three inches and a fraction. Tablets half as broad, or twice as broad, may be introduced when required. The vertical measure of the tablets will vary to suit the size of the specimen. For the smallest shells an inch-wide tablet will be sufficient, others may be one and a half, two, three, or four inches, or more; but always some definite size, so that any space at the lower end of the column may be filled up with a blank tablet. Very minute or fragile specimens should be gummed to black paper, and shut up in a glass tube or box, which may be fixed on the tablet. Mr. Gaskoin kept his collection of *Columbellæ* in little glass boxes, such as may be had at all the shops, and the specimens were thus preserved cleaner and safer than in any other way. In labelling, it is desirable to write the generic and specific names (with the *authority* for the latter), and the locality, distinguishing whether it be the actual locality of the specimen, or only the known habitat of the species. Some naturalists represent this by the sign (!), which implies certainty.

For determining the *specific* names of shells, it will be necessary to consult other books than those we have referred to. Many persons bring their shells, a few at a time, to the British Museum, and name them by comparison with the specimens in the national shell gallery. It is still better if access can be obtained to a cabinet where close inspection is possible; but in any case it is desirable to test the information so obtained by comparison with the figures and descriptions in conchological works.

The principal works which describe and figure the species of shells are:—

Reeve (Lovell), "Conchologia Iconica," 4to, London, 1842—60, in 200 parts, containing full-sized figures of about 10,000 species, or half the known shells, price £100.

Sowerby (C. B.), "Thesaurus Conchyliorum," 8vo, London, in 19 parts with 222 coloured plates, containing reduced figures of about 5700 species, price £19 19*s.*

Wood (Wm.), "Index Testaceologicus," 8vo, London, 1828, with 46 coloured plates, containing 2780 very small figures, original price £6 15*s.* Ed. 3, by Sylvanus Hanley, 1856, price £3 10*s.* 6*d.* Appendix, by Hanley, with text to original work, 1842—56 (small paper, with coloured figures), £2 2*s.*

These books can be consulted in the reading-room of the British Museum, and in the rooms of the scientific societies and great libraries, at least in London.

In preparing these remarks on shell-collecting, we have reckoned on the ready sympathy of the readers of the Recreative Science in all natural history pursuits. We do not, however, pretend that ours is a very ennobling or intellectual amusement. It yields the same kind of satisfaction with field botany, which leads us into quiet communing with Nature; and adds, if actively pursued, the excitement which attends on fishing, which is sometimes considerable, with a light breeze at sea. The anatomical study of shell-fish requires talent of a higher order, with more patience, and the result is the unfolding of wondrous exhibitions of constructive and adaptive skill; but this is a branch which few can prosecute. Shell-collecting is in itself an elegant pursuit, and the contemplation of the treasures is always highly satisfactory. Shells are so symmetrical in form, rich in colour, varied in pattern, and wondrous in their architecture, that we never tire of setting them out and discussing their merits; and we will not be put out of conceit with our own specimens because they are not unique or costly—they have cost us quite enough, and many of them are specially regarded as souvenirs of early expeditions, and gifts of valued friends.

S. P. WOODWARD.

British Museum.

THE "WHIRLIGIG" BEETLE. (*Gyrinus natator.*)

EVERY observer, whether resident in town or country, must have noticed, on the surfaces of pools and ditches, numerous wavy lines, caused, during the warmer months of the year, by the gyrations of a little shining insect; but few persons are aware of the true nature of this insect, and less still, even amongst naturalists, are acquainted with all the wonderful appliances with which it is endowed, to provide for its wants, and adapt it to its aquatic habits of life.

The little insect in question is vulgarly known as the "Whirligig," or the "Shiner." It belongs to the beetle tribe (as will be seen from the magnified view of it in Fig 1), and is framed in such a manner as to mock all the devices and contrivances that engineering talent has ever conceived, or the hand of man constructed, for the purposes of aquatic or aerial locomotion.

In fact, it is, as we shall find, a living ship, bearing, within and about it, all the needful fuel and machinery to insure a rapid transit upon, below, or above the surface of the water, and over any floating object that may impede its course; and we are sure that half an hour spent in the investigation of its wonders will not be passed entirely without profit or pleasure.

If you were to consult the most recent and accurate treatises on zoology, and turning to the history of the insect races,* were to glance over the list of Coleoptera,† or beetles, you would find that they are more numerous than any other order; and on this account chiefly they have been difficult of classification.

In the first place, the whole order has been included, by the greatest naturalist of the age,‡ in a sub-class of insects, which he terms *Tetraptera*, in consequence of their possessing four wings; whilst another great zoologist§ groups them amongst the *Holometabola*, that is to say, the section of Insecta, in which the contained forms undergo a complete metamorphosis, first from the larval to the pupal or chrysalis state, and then to the perfect or imago form.

Now, we shall certainly gain nothing if we try to reconcile the arrangements of these two naturalists, and say that "the beetle

* The most prominent features by which a true insect may be distinguished are—1st, an external horny case or envelope of *chitine*, divided into rings or segments; 2nd, *three pairs of articulated legs*, and one pair of articulated feelers, and, 3rd, usually one or two pairs of wings. Their life history is characterized by a more or less perfect metamorphosis from the imperfect or *larval*, through the *chrysalis*, to the perfect or *imago* form.

† So called from two Greek words, signifying "a sheath' and "a wing,' the *elytræ*, or wing-covers, serving as a sheath for the more delicate membranous wings.

‡ Cuvier. § Vogt.

tribes belong to those insects that have four wings, and undergo a complete metamorphosis;" for there are not only many insects possessing four wings that do *not* undergo a complete transformation, as, for instance, the dragon-fly (*Libellula*), the ant-lion (*Myrmeleo*), etc. etc., but there are also some which, whilst they *do* pass through the stages of larva and pupa, before attaining their perfect condition, are only furnished with *one* pair of wings, such as the common house-fly, and various genera of the dipterous or two-winged group.

Without reference, therefore, to any special classification in this respect, we must remember that the beetle tribes possess four wings, and undergo a complete transformation, and must descend to the next specialization to which they are subject. In this, however, all naturalists are agreed, and the *order* is universally known as that of *Coleoptera*, from the peculiar character of the wings already referred to. These consist of the elytræ, or wing-cases, and the true wings, which, when not in use, lie folded up beneath the former.

Proceeding downwards from the *order*, we find that Cuvier has designated the particular section of Coleoptera, to which Gyrinus appertains, *Pentamera*, in consequence of the last joint of the foot being divided into five segments; but it is the *family* distinction (drawn by most naturalists from the movements and *habitat* of the little creature) that is most deserving of notice.

One zoologist* has designated the *family Hydrocanthari*, in consequence of their aquatic habits; others, attracted rather by their movements, have bestowed upon them the title of *Gyrinida*,† or *Gyronechina*,‡ from the rapid gyrations that they perform in the water; whilst Cuvier, having distinguished the *group*, *order*, and *sub-class* by a reference to the peculiarities connected with the feet and wings, has, consistently enough, designated the family *Palpicornia*, from the horned appearance of their feelers.

Notwithstanding these diversities, however, in the *family* titles bestowed upon the group to which the Whirligig appertains, zoologists are agreed in designating the insect itself *Gyrinus natator*,* the first name serving to denote its *genus*, and the second its *species*;† and thus we see that, so far as concerns its *class*, *order*, *genus*, and *species*, it has been designated alike by systematic naturalists.

So, then, we find that the little creature whose beautiful structure we are about to investigate, *Gyrinus natator*, is an insect belonging to the *order Coleoptera*, or beetles, and is included in the *family* of *Hydrocanthari*, or *Gyrinidæ*, the gyratory water-beetles, and that it may easily be assigned to the highest sub-class of insects, in consequence of the perfect metamorphosis that it undergoes during its life.

And now, when we come to examine the little *Gyrinus*, with a lens magnifying about fifteen or twenty diameters (Fig. 1), we find the comparison with a sailing craft to hold good from the very outset; for if we were asked what form it presents, we should at once unhesitatingly pronounce it to be boat-shaped. In order to give it this external configuration, the constrictions usually found in the bodies of insects (as will presently be explained) have been dispensed with, and a nearer examination of the framework serves to show that it is constructed on the model best adapted to enable it to effect a rapid transit over the surface of the water.‡

The continuous line from the head to what may be popularly called the tail of the beetle, results from the partial fusion of those

* Burmeister. (Zoological Atlas.)
† Vogt. (Zoological Letters.)
‡ Carpenter. (Zoology.)

* The "swimming gyratory" beetle.
† There are seven other known species of Gyrinus in Great Britain.
‡ As engineers would say, it combines a light draught of water with great speed.

three parts or sections into which the bodies of all insects are divided, namely, the *head* (Fig. 1, *a*), the *thorax* or chest (Fig. 1, *b*),

FIG. 1.

of which a portion only is here visible, and the *abdomen* (Fig. 1, *c*), which is almost entirely concealed by the elytræ, or wing-cases.

Not only are these three parts—the *head*, *thorax*, and *abdomen*—distinct, and, generally speaking, united only by narrow constrictions in the insects contained in many other orders,* but even amongst the beetles themselves they are frequently well defined.† In *Gyrinus*, however, they are distinguishable only by indentations on the external surface; but, notwithstanding their partial fusion, we shall find on each section the appropriate organs and members that are usually appended to it in insects in which the division is more complete.

Beginning at the head (Fig. 1, *a*), we at first sight perceive no other appendages than a pair of small tufts, situated one on either side, in which you will no doubt recognize the *antennæ*, or *feelers*; and even these are frequently concealed in a couple of indentations between the eyes, into which they can be retracted at the will of the insect.

These are, however (as we shall presently find), far from being the only organs situated upon the head; but we shall, before proceeding to the others, detach one of them, and submit it to a nearer examination, in order to make ourselves acquainted with its form and structure.

The antennæ do not consist simply of a club-shaped member, as a superficial inspection might lead us to suppose, but they are composed—1st, of a very small *basal joint* (Fig. 2, *a*), by which they articulate with the head; 2nd, of a large, somewhat globular member (*b*); to which is appended—3rd, a curious ear-shaped limb, fringed with long hairs (*c*).

FIG. 2.

From the second of these joints, however, there proceeds the *clavate*, or club-shaped appendage (Fig. 1, *d*), and which consists of seven cylindrical rings, very small and narrow at first, but becoming enlarged as they approach the extremity. The whole feeler is, therefore, as you see, a somewhat complex mechanism, and an examination of the internal structure has shown this to be still more complicated.

The purpose for which these antennæ are employed remains undecided. Some physiologists believe them to be organs of *smell*, others of *hearing*, others again of *touch*;* whilst an American observer has lately expressed his opinion that, in some insects at

* As, for example, the fly amongst the *Diptera*, or two-winged insects; the common cabbage butterfly amongst *Lepidoptera*; the honey-bee in *Hymenoptera*.

† *E. g.*, the Spanish-fly (*Lytta*, or *Cantharis vesicatoria*); the burying-beetle (*Necrophorus vespillo*).

* See "Earthworm and House-fly," by the author.

least, they serve to pilot the creature in its movements through the atmosphere.*

If they serve to pilot our little animated craft, they are, as we shall presently see, not the only appliances situated upon the head that are destined for this purpose, and whatever other function they may possess, it is tolerably certain that they are, strictly speaking, feelers, as their name denotes. The mystery connected with them is greatly increased by the fact that they are furnished with a vast number of organs of sense, visible only with the aid of a high microscopical power, each of which communicates, by means of a little nervous fibre, with a large central nerve or trunk proceeding to the brain.

Unfortunately, our restricted space will not admit of these minute scientific investigations, however interesting they may be: and we must now reverse the position of our little swimmer by turning it upon its back, so as to disclose its remarkable *oral apparatus*, as it is termed (Fig. 3, *a*, and Figs. 4 and 5); in other words, the organs of the mouth.

Fig. 3.

The character of this apparatus, which may at once be recognized with the assistance of a pocket lens, at the anterior portion of the head, shows the little creature to be an animal of prey. Formed upon the typical model of the insect tribes, it consists of the following parts:—A pair of powerful jaws, or *mandibles* (Fig. 5, *a*), and a second pair, termed the *maxillæ*, visible in Figs. 4 and 5, *b*. These jaws are so placed that they work horizontally, as may be seen in Fig. 4; and attached to the last named we find the

Fig. 4.

maxillary palpi (Figs. 4 and 5, *c*), which are supposed to test the character of the food before it is taken in at the mouth.

Besides the jaws, which, as just observed, work *horizontally*, *Gyrinus* possesses an upper and an under lip, *labrum* and *labium;* and to the latter, again, there is appended a second pair of feelers (Fig 5, *d*), the *labial palpi*.

Fig. 5.

These lips operate *vertically*, as do our own; and they, along with the rest of the oral apparatus, are powerfully made, and composed of a strong horny substance.

Leaving for a while the consideration of our little insect, let us indulge for a moment in a fanciful reflection that has engaged our

* March Number of the "Zoologist," p. 6808, 'On the Functions of the Antennæ of Insects.' Van Voorst. *

thoughts in the course of these investigations.

You have, no doubt, often pondered over the terrible catastrophes to which steamboats are liable, notwithstanding the vast number of rules and precautions that have been framed and laid down for their avoidance; but no such ridiculous thought has ever entered your mind, as that they might be prevented, if one could only provide each vessel with a bowsprit, capable of communicating to the helmsman any "dangers a-head," and a couple of pilots with eyes capable of looking in every direction at the same time!

Notwithstanding the absurdity, however, of such an idea, when conceived in connection with an inanimate sailing craft, we shall find it to be perfectly rational as applied to *Gyrinus*. Nay, when we come to examine the contrivances with which our little navigator has been furnished for its safety in this respect, we shall find them to be far more remarkable than either the sharp-sighted pilots, or the sensient bowsprit; for it must be remembered that not only is the insect compelled to steer clear of objects that impede its course whilst swimming (in comparison with which the passage of the swiftest steamer is but a snail's pace), but it has enemies in the depths below, and in the heights above, whose attacks it is necessary to avoid: and thus you will see that *its* pilots must not only be able to survey the surface of the water, but they must keep a sharp look-out above and below, so that the little creature may avoid collisions, and escape an untimely end, through falling a victim to the predatory tribes of water or air.

The *antennæ*, or feelers, already described, comprise the sensient bowsprits and communicate with the brain, or steersman, in the manner already described; and as to the sharp-sighted pilots, they are represented by the wonderful eyes of the insect, which we shall now proceed to examine.

You are doubtless aware that the difference between your own eyes and those of an insect consists in the former being two in number, each furnished with an exquisitely formed contractile iris, that adapts the eye to receive the images of objects at various distances, and also suitable muscles enabling it to survey the whole circle of vision; whilst the eyes of insects, usually five in number, that is to say, two compound and three simple, are composed of a vast number of smaller eyes directed to various parts of the external field, but unprovided with any apparatus for regulating distances, and perfectly fixed and immovable.

Each of the compound eyes consists, as just remarked, of a number of *ocelli* (little eyes, or eyelets), and every one of these is again a complete organ of vision, constructed upon the principle of our most perfect optical instruments (probably long before man was created), and presenting evidences of a designing power which, if there were no other, would of themselves testify to the existence of an All-Wise and Omnipresent Creator.

And in no insect is this proposition more beautifully and forcibly exemplified than in that under consideration; for in most others, the ocelli (Fig. 7, *a*), constituting the compound eyes, are collected into the masses of a more or less oval form, and as you will probably have noticed in the bee, fly, butterfly, and some of the beetle tribes, these composite masses are placed one at each side of the head.*

In order to adapt our little water-beetle, however, to its peculiar habits of life, Nature has so arranged that each of its compound eyes is divided horizontally, by what is termed a *septum*† (Fig. 6, *a*), into two parts,

* The ocelli are, in all probability, normally round, but become hexagonal in the course of development as a result of their agglomeration.

† *Septum* is an anatomical term used to denote parts of the body, or membranes, that serve as a partition between other parts; such, for example, as the *septum* dividing the nostrils.

the one situated on the superior surface of head (Fig. 6, *b*) and looking upwards to the

Fig. 6.

sky, and the other (Fig. 6, *c*) placed underneath so as to survey the watery field below. So that, in fact, the little creature is, practically speaking, furnished with two sets of compound eyes, the one set destined to warn it of the approach of its aerial enemies, the other to guard it from the attacks of its foes beneath.

When these eyes are examined through a low magnifying medium, they resemble little lentil-shaped objects covered with a bright varnish (Fig. 6), but a higher power reveals

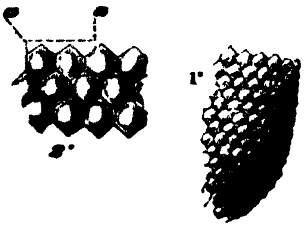


Fig. 7

the innumerable hexagonal facets, or eyelets (Fig. 7, 2' and 1'), of which they are composed.

The simple eyes (which on other insects resemble those of the house-spider) are absent in Gyrinus.

Now, let us suppose for a moment that some bird is about making a descent upon our little whirligig, the latter being furnished, as you actually find it, with its sharp-sighted pilots, and those on the top of his head we will presume to have warned him of the approach of his enemy, how, think you, will he effect his escape? Not by flight, for his cumbrous wings would hardly enable him to elude the enemy in his own element; nor yet by skimming the surface of the water, for the bird, being by far the larger animal, would there possess the advantage also. "Well, of course," you say, "it would at once dive under water." A very safe expedient, reader, and one to which the little insect has recourse, as we have found to our great annoyance whilst seeking to provide ourselves with specimens. But you must not forget that insects are *air-breathing* animals, and the atmosphere is admitted into their bodies, not through the mouth as with us, but through little punctures in the external investiture of the body, called stigmata, situated between the rings of the abdomen; hence it is conveyed by means of suitably constructed tubes (tracheæ) into every part of the system. The question therefore arises, how is the little beetle to be supplied with air whilst it is immersed in the water?

The solution of this difficulty is accompanied by a lesson of the deepest interest to the reflecting observer, for here again we find that the end which man has only been able to attain after years of thought and labour, is accomplished in this little insect in the simplest and most efficient manner, without the aid of any complicated machinery. If you catch a whirligig and place it in a bottle of water, you will perceive that whilst it is performing its beautiful and rapid gyrations beneath the surface, a little glistening bubble of air constantly adheres to what we may familiarly designate its tail.

The creature provides itself with this store of oxygen by the aid of two little wartlike protuberances situated at the extremity of the abdomen (Figs. 1 and 3, *r*), these being furnished with hairs or bristles (*setæ*), to which an air-bubble adheres when the insect quits the surface. This bubble of air appears to serve for a time as the necessary means of respiration, and as often as it needs renewal the insect rises to the surface of the water, just as do the air-breathing amphibia amongst the vertebrate animals.*

Besides this, there is no doubt a quantity of air always stored up beneath the wing-covers, the peculiar manner in which the wings are folded under them causing a kind of cellular cavity to be formed, very suitable for the retention of air.†

Quite equal in interest with the organs and members of the head and abdomen, and, if anything, still better adapted to its habits of life, are those which we shall find upon the *thorax* or chest, the middle section of the body of *Gyrinus*. As before stated, the greater portion of the dorsal, or back-surface of this section is concealed by the *elytræ*, or wing-covers, the first ring only, upon which the head articulates, being plainly distinguishable (Fig. 1, *b*).

On the ventral, or under-surface, however, the three divisions of the chest (which are common to all insects) are distinctly traceable. Of these (Fig. 3) the anterior segment, called the *pro-thorax*, serves as a support to the front pair of legs only; to the middle segment, or *meso-thorax*, are appended the wing-covers on the dorsal, and the second pair of legs on the ventral surface; and the hinder, or *meta-thorax*, bears on its dorsal portion the true wings, and on the ventral side, the third or hind-legs, which we shall presently find to be the most remarkable of all its members.*

The true wings usually lie concealed beneath the elytræ, or wing-covers, as they are seldom employed for flight, but, when occasion requires, the wing-covers can be lifted and the larger membranous wings expanded. Whilst they are in use, the wings have the appearance represented in Fig. 8, *a*; but when no longer required, they are folded up neatly beneath the elytræ, as shown in Fig. 8, *b*. The wing-covers themselves, one of which is here depicted (Fig. 8, *c*), are covered with rows of punctures, but whether these latter are merely for ornament, or whether they serve some object of utility, such as aëration, or lightening the wing, we are unable to say with certainty.

Again, the opportunity presents itself of instituting a comparison between our little living craft and the marine appliances invented by man. There is no doubt that some of the most beautiful contrivances have been perfected by him for the propulsion of vessels through the water, but although the marine engineer might be indignant at the assertion (unless he remembers who is the Maker and Designer), yet must we state that he has not yet been able to approach the same apparatus in our little water-beetle, either for simplicity of design or efficiency in execution.

But he has only to contemplate the instruments themselves, or to observe the rapidity with which they propel the creature through its native element, and the mechanician will be amongst the first to recognize the truth of our statement, and to acknowledge their perfect adaptation to the purposes they are intended to fulfil.

* *E g*, The whale, seal porpoise and all air-breathing animals that spend a portion of their time under water.

† In reference to the diving bell, it may not be out of place here to speculate that just as man is now able, through his knowledge of organic chemistry, to maintain the "balance of life and death in his aquarium (see RECREATIVE SCIENCE, vol. i., p. 226), so may he at no very distant period render his control over Nature subservient to the support of his own life for a longer period than he can at present beneath the water's surface. Such a result obtained from the study of Nature's laws, and practically applied, would be valuable beyond estimation.

* In insects which have four wings, the arrangement is the same, excepting that the front wings occupy the place of the elytræ of the *Coleoptera*, and where only one pair of wings is present, as in the house fly, these are the anterior ones, the hinder pair being only rudimentary, and assuming the form of *halteres*, or poisers. In all cases, however, the disposition of the members of locomotion on the three sections of the thorax remains the same.

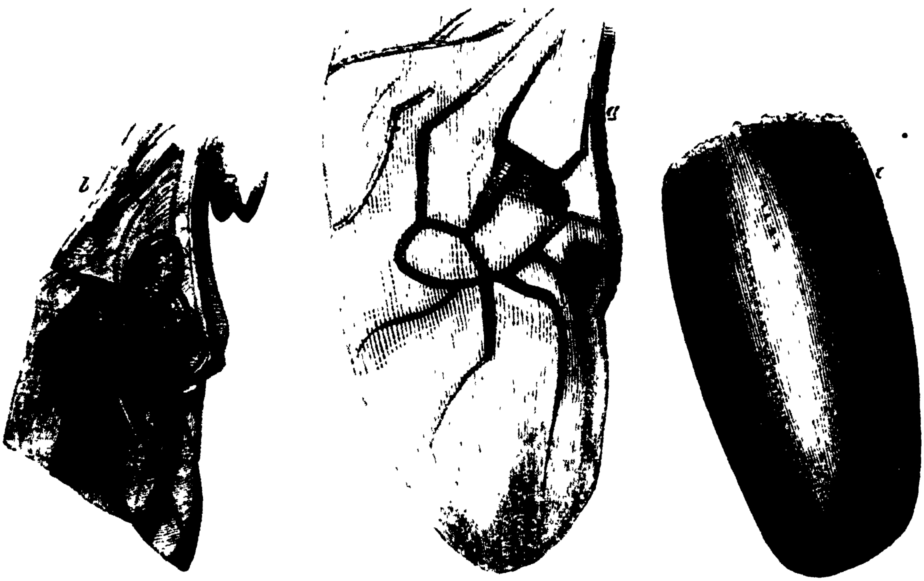
The legs of all insects are, as you probably know, divided into five distinct segments—1st, the *coxa* or hip, which is the joint whereby the limb is articulated with the body (Fig. 9, *a*); 2nd, the *trochanter* (Fig. 9, *b*), the *femur* (Fig. 9, *c*), the *tibia* (Fig. 9, *d*), and the *tarsus* or foot (Fig. 9, *e*), the last named being sub-divided into a variable number of joints in the different insect races.

Now let us see how Nature has moulded these several limbs in *Gyrinus*, so as to render them subservient to the ends for which they are required. The fore-legs, you will observe at the first glance, are not adapted for swimming, being of considerable length compared with the rest and with their own breadth, and furnished at the extremity of the tarsus (foot) with two sharp claws.

Although ill-adapted for natatory purposes, however, this pair of legs is well suited for the prehension of prey, and for progression over objects floating in the water.

A striking contrast to this pair is presented by the third, or posterior, pair of legs, in which the *coxa* and the *trochanter* are very small, whilst the *femur*, *tibia*, and *tarsus* are developed into a broad, flattened oar, which forms the chief instrument of progression (Fig. 9, *pp*).

These legs are so shaped as to present the greatest possible surface to the water, and to this end, also, the tibia and tarsus are furnished on both sides with a fringe of strong hairs which give additional breadth to this wonderfully constructed oar.



But this is not all; to the last tarsal joint there is attached a pair of strong hooks, such as we found on the anterior members, so that you see Nature has provided the little insect with a pair of exquisitely formed paddles, terminated by a couple of pairs of serviceable boathooks!

The middle pair of legs (Fig. 9, *mp*) is intermediate between the other two pairs, being much shorter than the anterior, but not so broad as the hinder pair, upon the model of which they are framed. How exquisitely perfect is this mechanism, whereby our little navigator is enabled to progress through the watery element! How wise must be the mind by which it was conceived!

And now let us for an instant contemplate its operation. Imagine the little creature as it is performing one of its gyratory feats on

the glassy surface of some tranquil pool, coming into contact with an obstacle that impedes its course; see with what rapidity and precision it seizes the floating object with its long anterior legs, first hooking on by its claws, whilst the two pairs of paddles give it the necessary impetus in the water; then, how the second (or, as we shall call them, the amphibious pair) scrambles after the first, also grasping the floating object with the terminal claws, the posterior paddles still remaining in the water ready for action in case the creature should fail to "land" itself by means of the first and second pair, and following sluggishly after the manner of a turtle's fins. But the whirligig is essentially a natatory insect, and you may now decide for yourself whether these limbs are not, in common with the remainder of its frame, most perfectly adapted to its habits of life.

Constructed on the best model for progression in the water, furnished with a sensorial apparatus of the most perfect kind, to enable it to direct its course with unerring certainty, and to perceive the approach of the predatory tribes above and below, provided with remarkable appliances that impart to it the power of rapid locomotion in, as well as upon the surface of the water, on land, and in the atmosphere, and filled with an internal machinery to keep these external appliances constantly supplied with motive force (just as the product of the fuel is circulated through the body of the locomotive engine), so framed and organized is this insignificant little water-beetle, which you have no doubt often listlessly watched, as it performed its aquatic gyrations, little dreaming of the interest attached to its structure and habits of life.

And now, one word in conclusion.

If there were any evidence necessary to prove that the Nature of the Deity is superior to our own, it is certainly to be found in the comparison of these creations of His, with the workmanship of mankind.

Setting aside the mysterious influence of *life*, which is the motive power in ourselves in common with all other creatures, and which He alone can bestow, the instruments whereon it operates are manifestly the work of a Superior Being, who has, in deputing to us the fulfilment of a portion of His wise and infinite scheme in the universe, imparted to us an inventive power and executive influence to some extent resembling His own.

It is the due exercise of these powers in the faithful performance of the trust thus reposed in us that leads to the formation of strong and healthy intellects, and, we hope, paves the way for that higher stage of usefulness in which all may become perfect, even as our Father in heaven is perfect.

Liverpool. JAMES SAMUELSON.

THE PORTABLE EQUATOREAL.

At page 165 of the first volume of RECREATIVE SCIENCE, there is a general description of a portable equatoreal. Since the publication of that description, the writer has had many communications, requesting a more detailed description of the instrument. It is proposed, in the present article, to give a description sufficiently practical to enable an optician, or a good working amateur, to apply the principle to practice.

For the sake of simplicity, the subject may be considered under two heads. I., The astronomical; II., The mechanical. Two or three words in reference to the first of these may suffice, in addition to those in the article referred to.

In order to enable an observer to use the equatoreal in any way at all satisfactory, it is absolutely essential that he should have a *good eight-days' clock*, with a *seconds' pendulum*. It is also absolutely necessary that he should have the means of ascertaining the error and rate of his clock by independent means. In order to do so, let him construct a meridian-line (a description of a simple one is given at page 353, vol i. of this work). If he possess a transit-instrument, and know how to use it, so much the better.

Supposing the reader to have the means of ascertaining the true local time, we proceed to show how this becomes one of the first steps in the use of the equatoreal.

1. It is essential that he should have a South or North mark. A little thought will suffice to show how this may be obtained by the same means required for ascertaining the error and rate of the clock.

This is almost too simple a matter to require anything to be said about it. If two plumb-lines be fixed approximately in the plane of the meridian, so that a tap with a hammer may adjust one of them, and the observer wait till the sun, or a star or planet, be on the meridian, he will be able very soon to ascertain what object in the *horizon* is in his meridian; the more distant the better, as a movement of a few feet on his premises will then not throw the mark sensibly out for the purpose of using the equatoreal.

2. Supposing the reader to have fixed his mark, he must now so adjust his equatoreal that, when the telescope is directed to the South mark, the hour-circle index shall read 0; and if the telescope be placed horizontally, and also directed to the South, the declination-circle index shall read the amount of declination South, which corresponds with the elevation of the celestial equator above the horizon. At my station this is 38° 32′; but as two minutes of arc are not of any importance in the use of the instrument, it being all along supposed that the portable equatoreal is to be used as a *finder*, and not a *measurer*, I disregard them, and call it 38½, which is also quite as nearly as the smallness of the circles allows the readings to be taken.

The two adjustments already spoken of are now (we will suppose) completed, namely, the *southing*—so to speak—and the south *levelling* the latter being accomplished by placing an ordinary spirit-level on the outside of the telescope), disregarding altogether the *line of collimation*, which the rude character of the instrument renders it unnecessary to regard, unless it be egregiously large; and then the maker should have the instrument returned to him.

3. The next adjustment is to turn the telescope so that the hour-circle index shall read 6 hours from noon, either way, before or after. The declination-circle index must now be set to 0 (the equator). The instrument, being now in the direction East and West, must be levelled as it was when directed to the South. One of the three foot-screws will be used for this purpose, as also with the southing. The process must be repeated once or twice, as it cannot be done at once, unless by accident. After a few trials, it will be found that the instrument is adjusted, so that when directed to the South and levelled, the hour-circle index reads 0, as before stated, and the declination equals the co-latitude; and that when directed East and West, the hour-circle index reading 6 hours from noon, and the declination-circle index reading 0, the instrument is level, and therefore in a state of adjustment. In proportion to the care with which these matters are performed, will be the probable success in getting an object in the field. It must be remembered that, although the end aspired to is an humble one, viz., that of having one particular point in the field of view, a person who is careless in adjusting the instrument may easily fail in his object by an accumulation of small errors; for instance, he may be *too* rough in *levelling*, and he may be too rough in reading the *index*. One of these would not be an important error, but both together may throw the object out of the field, and lead to a throwing of the blame on the instrument, while it properly belongs to the observer.

4. One or two words more may be sufficient in regard to the astronomical part of the subject. Say that the equatoreal is adjusted so that the observer can direct it to any part of the heavens which its construction admits of. (We shall have something to say about the necessary *limits* to this under head II.) It only remains to remind him that, with the "Nautical Almanac" before him, and the true time in his pocket, he is fully armed for an attack on the heavens; and if he succeed in capturing a comet, we shall congratulate him. With the above-named valuable blue-book before him, he will have no difficulty in finding when any object whose R.A. is known will be on his meridian, and if its N.D. or S.D. be also known, at what point he must set his declination-circle to find it. He will then immediately see, by looking at his clock, that the object is so many hours, etc., east or west of his meridian; and by setting the hour-circle accordingly, he will be able to direct the telescope to the required point in the heavens. To any one who is not familiar with the "Nautical Almanac" we may remark, that the mean time of the southing of the first point of Aries is given for every day in the year in that Almanac, and therefore a very little calculation (reducing sidereal to mean time, etc.) will show how long, before or after that hour, the object sought for will be on the meridian. For instance, suppose I want to find Arcturus at 3 p.m. on July 21, 1861, I find the first point of Aries is south at 4h. 4m. a.m. (or July 20, 16h. 4m. astronomical). Arcturus, R.A. mean time interval = 14h. 7m., which gives 6h. 11m. p.m. as the time when Arcturus will be south. At 3 p.m., therefore, he is 3h. 11m., or 47¾° to the east of south. His declination is about 20° north. At 3 p.m., therefore, July 21, the declination-circle being set to 20° north, and the hour-circle to 47¾° east of south, Arcturus will be in the field.

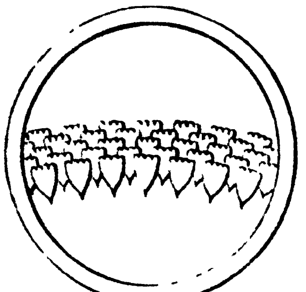
The further consideration of the construction is reserved for a future paper.

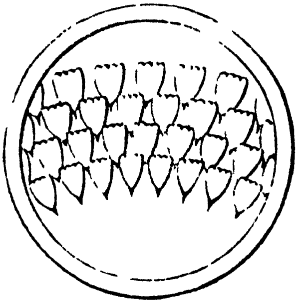
WILLIAM C. BURDER.
Observatory, South Parade, Clifton.

HOW DO BUTTERFLIES' WINGS GROW?

WILL the microscopist tell me how butterflies' wings grow, on emerging from the chrysalis case, with so wonderful and steady rapidity? This must have passed through many observers' minds, on seeing that most curious process; and various theories have been started to explain it. Some have thought each little scale expanded in size along with the membrane of the wing, by the entrance of the air, when breathed by the newly unshrouded insect; and others have conjectured an actual growth of vegetable-like nature in the whole substance of the wing, without, however, being satisfied with so vague an idea. Observations with the microscope, for the purpose of solving this interesting point, have shown me something of the process, which may be generally interesting. If we take a chrysalis, which by its colour and motion gives signs of being within a day or two of coming out, it is easy, with a little care, to remove a portion of the case, just above the wing, as it lies about one-eighth of its future size, ready to be unfurled. This can be done quite safely at this stage of its progress, without in any way injuring the insect, or preventing its emerging in full beauty a day or two afterwards.

Now, examining with the microscope the exposed part of the wing, the little scales will be found,* by comparison with a full-grown wing, to be themselves already each quite of *the same full size*, but placed so much overlapping each other, that only the extreme tip of each is seen below the scale above it. Examine the same scales after the creature has been out long enough for its wings to be fully spread, and they will be found to have been drawn out from under each other, so far that much the largest part of each is to be seen *slid out* from under its





neighbour above it: but the actual size of each scale is not at all changed. The two different positions are somewhat like these sketches of what the microscope shows.

It seems, then, that in the chrysalis, each row of scales is simply shoved close under the other, taking with it a fold of the membrane they are attached to; and, at the same time, each in the row is pressed closer to the one next on either side of itself, so that both lengthways and breadthways they can afterwards be extended. By the admission of air into the main nervures of the wing, these act as springs to extend the membrane; and both pull out and draw further apart the rows of scales. So neatly are they packed by the GREAT WONDER WORKER, whose pleasure in his works must indeed be intense, when contriving and superintending such delicate arrangements, whose observation alone fills us with delighted admiration.

This is but one instance of the curious discoveries the aid of the microscope affords about butterflies' wings. Another I will just mention—it is the *change of colour*, which such closer inspection sometimes reveals. The lovely little orange tip, whose name (*Euchlæ*) in Greek means "very green," from the exquisite green mottling of the under part of the wings, will be found not to have one green scale on it. What seems so green is a mixture of black and yellow, which blend so as to seem green enough, certainly, to the unaided eye.

Perhaps this may be a hint in optics, as well as in natural history,

C. Hope Robertson, M.A.

Muckross, Killarney.

Nov. 9, 1860.

METEOROLOGY OF FEBRUARY.

FROM OBSERVATIONS AT HIGHFIELD HOUSE OBSERVATORY.

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Year.	Mean Temperature of the Air. Degrees.	Mean Temperature of the Dew Point. Degrees.	Mean Pressure of the Air. Inches.	Mean Amount of Cloud. (0—10).	Number of Rainy Days.
1846	43·2	—	—	6·4	10
1847	36·8	35·0	29·663	6·1	15
1848	43·3	38·8	29·492	7·0	24
1849	40·9	37·1	30·071	6·0	14
1850	43·2	39·6	29·753	6·7	10
1851	39·2	35·6	29·871	5·8	11
1852	40·0	35·1	29·846	6·2	18
1853	32·6	28·5	29·600	7·1	17
1854	39·2	33·8	30·002	6·1	10
1855	28·4	26·4	29·632	7·1	17
1856	41·5	37·9	30·009	7·7	12
1857	39·2	35·5	29·901	7·0	14
1858	35·2	31·3	29·863	5·9	4
1859	42·1	36·3	29·743	6·7	13
1860	35·3	31·0	29·839	5·6	17
Mean	38·7	34·4	29·837	6·5	14

The mean temperature of the last fifteen years, for February, is 38·7°, the range in the mean temperature being from 28·4° in 1855 to 43·3° in 1848—a difference of 14·9°. The lowest means occurred in 1853 and 1855; and the highest in 1816, 1848, 1850, and 1859.

The mean temperature of the last fifty years, for February, is 38·6°, the lowest mean occurring in 1855, and the highest in 1817 (viz., 43·5°).

The mean temperature of the dew-point of the last fourteen years, for February, is 34·4°, the range being from 26·4° in 1855 to 39·6° in 1850—a difference of 13·2°, the lowest means occurring in 1853 and 1855; and the highest in 1848 and 1850. The temperature of the dew-point was in 1859 as much as 5·8° below that of the temperature of the air, and in 1847 as little as 1·8°; the mean difference being 3·9°.

The mean pressure of the last fourteen years, for February, is 29·837 inches at the height of 174 feet above the mean sea-level, ranging between 29·492 inches in 1848, and 30·071 inches in 1849—a difference of 0·579 of an inch (or nearly six-tenths of an inch). To reduce these readings to the sea-level, it is necessary to add 0·195 of an inch, when the mean temperature is as low as 28·4°, as in 1855; and 0·189 of an inch when it is as high as 43·3°, as in 1848. On applying this correction, the mean pressure, reduced to the sea-level for February of the past fourteen years, is 30·028 inches.

The mean amount of cloud, for February, of the past fifteen years is 6·5; the amount ranging between 5·6 as in 1860, and 7·7 as in 1856—a difference of 2·1, or a fifth of the whole sky.

The mean number of rainy days for February of the past fifteen years is 14, ranging between 4 in 1858 and 24 in 1848—a difference of 20 days. The years of but little rain are 1846, 1850, 1851, 1854, and 1858; and of much rain, 1848, 1852, 1853, 1855, and 1860.

February is usually a month with but little cloud.

E. J. Lowe.

ASTRONOMICAL OBSERVATIONS FOR FEBRUARY, 1861.

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The Sun is in the constellation Aquarius, passing into Pisces on the 18th. He rises in London on the 1st at 7h. 41m., on the 10th at 7h. 26m., on the 20th at 7h. 7m., and on the 28th at 6h. 50m.; setting on the 1st at 4h. 48m., on the 10th at 5h. 4m., on the 20th at 5h. 22m., and on the 28th at 5h. 37m.

The time the Sun is above the horizon in London is on the 1st 9h. 7m., on the 10th 9h. 38m., on the 20th 10h. 15m., and on the 28th 10h. 47m. (or 1h. 40m. longer on the 28th than on the 1st).

The Sun rises at Edinburgh on the 11th at 7h. 38m., and on the 22nd at 7h. 13m., setting at Edinburgh on the 12th at 4h. 54m., and on the 23rd at 5h. 18m.

The Sun rises in Dublin on the 7th at 7h. 40m., and on the 18th at 7h. 17m.; setting at Dublin on the 8th at 4h. 53m., and on the 19th at 5h. 15m.

Day breaks in London on the 1st at 5h. 44m., on the 15th at 5h. 23m., and on the 24th at 5h. 6m.

Twilight ends on the 4th at 6h. 49m., on the 16th at 7h. 8m.: and on the 26th at 7h. 25m.

At Edinburgh, the increase of day on the 4th is 1h. 52m.: at Dublin, on the 7th, the increase is 1h. 19m.

Length of day at Edinburgh, on the 12th, 9h. 18m.; length of day at Dublin, on the 13th, 9h. 35m., and on the 26th, 10h. 30m.

Length of night at Dublin on the 21st, 13h. 50m., and at Edinburgh on the 28th, 13h. 30m.

The Sun is on the meridian on the 5th at 12h. 14m. 19s.; on the 15th at 12h. 14m. 24s.; and on the 25th at 12h. 13m. 16s.

The Equation of Time on the 5th is 14m. 19s.; on the 15th, 14m. 24s.; and on the 25th, 13m. 16s., the equation being addative.

The Moon is new on the 9th at 8h. 5m p.m.

Full Moon on the 25th at 4h. 43m a.m.

The Moon is at her greatest distance from the earth on the 14th and approaches nearest on the 26th.

Mercury is an evening star, situated in the constellation Capricornus at the beginning of the month, passing through Aquarius into Pisces at the end of the month. He sets due east at the end of the month, and possibly may be visible to the naked eye. He rises on the 10th at 5h. 44m a.m., and on the 20th at 6h. 52m. a.m., and souths on the 10th at 12h. 17m. p.m., and on the 20th at 1h. 12m. p.m. Mercury is at his greatest eastern elongation on the 27th, viz., 18° 6'.

Venus is a morning star, small, and unfavourably situated for observation. She is attaining her circular form, situated in Sagittarius at the commencement of the month, and in Capricornus, at the close, she is near the Sun, and at her greatest distance from tha earth. Venus rises on the 10th at 6h 33m. a.m and on the 20th at 6h 28m. a.m., southing on the 10th at 10h. 43m. a.m., and on the 20th at 10h. 56m. a.m.

Mars is an evening star small in size, and near the Sun. He is in Pisces at the commencement of the month, and in Aries at the close. Rising on the 10th at 11h. 6m p.m., and on the 20th at 11h 6m p.m.; southing on the 10th at 4h 10m p.m. and on the 20th at 3h. 57m p.m.

Jupiter is now a most brilliant object, and visible throughout the night. He will be in opposition to the Sun, and at his nearest distance from the earth at 5h. 41m. p.m. on the 10th. He is in the constellation Leo, north of the star Regulus. His greatest apparent diameter will be on the 10th, viz. 42". Jupiter rises on the 10th at 4h. 52m p.m. and on the 20th at 4h. 3m. p.m., southing on the 10th at 12h. 19m. a.m. and on the 20th at 11h 30m p.m., setting on the 10th at 7h. 43m. a.m., and on the 20th at 7h 1m. a.m.

Saturn is an evening star and is situated in the constellation Leo, and is a fine object. He is in opposition to the Sun, and at his greatest brilliancy on the 24th, at 5h. 13m p.m., his apparent diameter being 18", the length of the outer ring 45" but with only a breadth of little more than 5". Saturn rises on the 10th at 6h. 17m p.m., and on the 20th at 5h. 33m. p.m., he souths on the 10th at 1h. 19m. a.m., and on the 20th at 12h 36m. a.m., setting on the 10th at 8h. 17m a.m., and on the 20th at 7h. 36m. a.m.

Uranus is favourably situated for observation, and is in the constellation of Taurus. He rises on the 10th at 10h 56m. a.m., and on the 20th at 10h. 19m. a.m.; southing on the 10th at 7h. 2m. p.m., and on the 20th at 6h. 23m. p.m.

Occultations of Stars by the Moon:—On the 16th, ε Arietis (4th magnitude) disappears at 11h. 52m. p.m., and reappears at 12h. 47m. a.m. On the 17th, Merope (one of the Pleiades, 5th magnitude) disappears at 9h. 59m. p.m., and reappears at 10h. 43m. p.m. On the 25th, p. 5. Leonis (5th magnitude) disappears at 8h. 18m. p.m., and reappears at 9h. 17m. p.m.

Eclipses of Jupiter's Satellites:—On the 1st, at 11h. 40m. 8s. p.m., 1st moon disappears. On the 2nd, at 1h. 25m. 17s. a.m., 2nd moon disappears. On the 3rd, at 11h. 54m. 16s. p.m., 3rd moon disappears. On the 6th, at 8h. 6m. 46s p.m., 4th moon disappears. On the 9th, at 1h. 39m. 53s. a.m., 1st moon disappears. On the 12th, at 8h. 13m. 2s, p.m., 2nd moon reappears. On the 18th, at 12h. 17m. 23s. a.m., 1st moon reappears. On the 19th, at 6h. 45m. 53s. p.m., 1st moon reappears. On the 19th, at 10h. 49m. 51s. p.m., 2nd moon reappears. On the 23rd, at 6h. 52m. 14s. p.m., 4th moon reappears. On the 25th, at 2h. 11m 27s a.m., 1st moon reappears. On the 26th, at 8h 39m 59s p.m., 1st moon reappears. On the 27th, at 1h 26m 11s a.m., 2nd moon reappears.

The variable star Algol will be at its least light in the evening on the 1st at 8h 59m. On the 4th, at 5h. 47m.; on the 21st at 10h 42m., and on the 24th at 7h 31m. He shines as a star of the first magnitude for 2 days 14 hours, then diminishes to the 4th magnitude in about 3 hours, and as speedily increases again to the 1st magnitude.

Stars on the Meridian.—On the 4th, Pleiades souths at 6h. 39m. 38s. p.m. On the 5th, Procyon souths at 10h 37m. 53s p.m. On the 10th, Regulus souths at 12h 40m 12s. a.m. On the 11th Aldebaran souths at 7h. 9m. 13s p.m. On the 15th Procyon souths at 9h. 48m. 34s p.m. On the 16th, Capella souths at 7h. 19m 26s. p.m. On the 18th, β Orionis souths at 7h. 12m. 59s. p.m. On the 19th, β Tauri souths at 7h 18m. 41s. p.m. On the 20th, Regulus souths at 11h. 57m 27s. p.m. On the 22nd α Orionis souths at 7h 30m. 56s. p.m. On the 23rd Sirius souths at 8h 21m 15s p.m. On the 25th, Castor souths at 9h 2m 58s. p.m. On the 27th Procyon souths at 9h. 1m. 23s. p.m. On the 28th Pollux souths at 9h 2m. 13s p.m.

E. J. Lowe.

THE MICROSCOPIC OBSERVER. FEBRUARY.

Liverworts.—This order of the *Muscales* has always been an interesting one, on account of the wide distribution of its genera and species, the extremely simple character of most of them and the interesting physiological details they present under the microscope. We have here the pretty *Riccias* which, growing in the same manner as *Lemna*, form beautiful and useful surface plants for aquaria; ***Marchantia***, which every young microscopist is eager to obtain, and never need search for long, with *Jungermannia*, *Anthocerotea* and *Pelliæ*, all more or less known as important families among cryptogamic plants. In their simplest forms they are frondose, that is, the structure exhibits no proper distinction of leaf and branch, as in *Anthocerotеæ*, *Marchantieæ*, *Ricciæ*, and *Pellieæ*. In the first of these the plant consists of a membranous substance, growing on damp ground, and to be distinguished from other humble productions of similar external appearance by the following characters. The fruits consist of stalk-like bodies springing up irregularly over the surface of the frond; around the base of each of these fruits is a sheath which has its origin in the surface of the frond. These fruits split longitudinally, and display a central columella, bearing spores and rudimentary elaters. In some of this family the frond consists of only a single layer of cells, containing chlorophyll, but in the next section, *Marchantia*, there are numerous layers of cells, an epidermis investing both surfaces, and stomata on the upper of them. The fruits of *Marchantia* arise out of notches in the lobed frond, and each fruit bears on its summit a cup variously notched, toothed, or lobed, in the different species. The spores occur on the underside of this cup. *Riccia* is a form of *Hepaticeæ*, better known than most others perhaps, because one of the most useful and beautiful of the minute plants used in aquaria. In the tank at the cool end of the Crystal Palace there are some pans of *Riccia*, unusually beautiful, owing to their excellent state of preservation, and their continual and rapid growth. The species of *Riccia* are numerous, and the most useful are specified in the "Book of the Aquarium" They all agree in having a lobed leaf-like structure, a distinct mid-nerve, and sporanges on very short stalks, or imbedded in the substance of the frond. The reticulated upper surface of the frond is covered with stomata. When the sporanges are imbedded in the frond the spores are emitted only by the decay of the sporange; it never bursts by any energy of its own. The strictly foliaceous forms of *Hepaticeæ* are all ranged under *Jungermanniæ*, which have a thread-like stem clothed with leaves imbricated at their bases. In these the sporanges spring from the end of the stem, showing an evident approach to higher vegetable forms. When the sporanges burst they take the form of a cross, owing to the expansion of the four symmetrically placed valves, the spores are furnished with elaters. These characters cause the frequent confounding of the *Jungermanniæ* with the Mosses, from which, however, they may be distinguished by the peculiar flattened arrangement of the leaves. The Liverworts are all freely produced in damp soils, on wet rocks, old timber, and on the surface of running streams. To get a supply of subjects of this class for study, procure a few of the patent cutting pots made by Mr. Pascall, West Kent Potteries, Chiselhurst, sold also by Messrs. Hooper, of Covent Garden. Give the preference to those of from 6 to 12 inches in diameter, and have them fitted with bell glasses. Fill one with half charcoal, then a layer of silver-sand, and on the sand a few rough pieces of freestone Saturate with water, cover with the bell-glass, and place in a moderate light. In the course of a few months there will be on the whole surface of stone and sand various forms of Liverworts of kinds peculiar to such a nidus. Fill another with sour peat, taken from pots in which ferns have grown some time. The less drainage the better, and there need be but little or no ventilation; this will also produce its own crop of interesting subjects. Fill another with a mixture of chopped sphagnum, broken flower-pots, and rotten wood, and leave it also to produce whatever forms may give it the preference. A carefully-managed collection will form no inappropriate adornment for a table in a study window, and will very well assort with ferns and aquaria. The species of *Riccia* are best kept in tall jars containing Valisneria, or in inverted six or eight-inch bell-glasses. If consigned to large aquaria they disappear in time, and have to be renewed, whereas in small vessels, with other subjects of like character, they may be largely increased, and will prove useful for exchanges between friends interested in microscopic studies.

Pollen and Coloured Cells.—It may be important for microscopists engaged in inquiries respecting pollen and coloured cells, to be reminded that *Helleborus lividus*, *Tussilago fragrans*, *Bulbocodium vernum*, *Cydonia Japonica* and *Cornus mascula* usually blossom in February. They will of course be later than usual this year owing to the late severe weather, but may be looked for a week or so later than their usual time.

Hairs of Plants.—The common groundsel, *Senecio vulgaris*, blooms during every month of the year, and after the severest frosts young plants soon appear and hasten into blossom, while those that have survived the frost will bloom in a temperature as low as 35°. We may, therefore, indicate the groundsel as a subject available now for the study of vegetable hairs These are produced over the whole of the plant, and when covered with heavy dew, give it a glaucous appearance They consist of two semicylindrical cells united along the length of their flat faces, so as to form a tube with a vertical septum, observable by means of a cross section. The contents, which are expelled when the hairs are placed in water, consist of a spiral, fibrous substance which untwists and expands to considerably more than the length of the hairs by absorption. Similar hairs may be found on the seeds of Acanthus, but the spiral fibres are unrollable. Other subjects of a seasonable kind are the hairs of the ivy, which are stellate and compound, and each supported on a short stalk cell. In the stove a few blossoms of some of the species of Salvia may now be obtainable; the calyx will furnish examples of clubbed hairs. The stellate hairs of the garden Alyssum, now making its new seasonal growth, are exquisitely beautiful objects, and will remind the observer of some of the examples of stellate silicated crystals from flints and sponges, which have been figured in former pages of Recreative Science. The common dead nettle, *Lamium album*, is one of the earliest plants in sheltered hedges, and will give examples of torulose hairs Returning to the groundsel we may remark that the pappus has toothed hairs.

will most probably fit a considerable number of flasks, and will thus amply repay the care we bestow upon it. Thus our retort is ready for use.

We must now find something which we may convert into a pneumatic trough. This oblong American tub, in which I wash my dirty glasses and tubes, etc., will answer our purpose admirably; so would the large hand-basin yonder, or the earthenware pan, but the oblong shape is most convenient. We want a shelf to our tub, and then it is complete. Here you see I have a small tin-plate perforated in three places. This we will support on two pieces of hard brick, and a very serviceable shelf is obtained (Fig. 2)

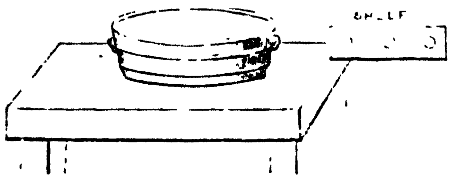
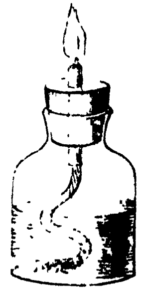


Fig. 2

We must next find some jars to contain our gas, and these we may procure from the confectioner. The large and small cake bottles, when emptied of their contents, may generally be picked up at a trifling cost, and have only to be properly prepared to make excellent gas-jars. We will select a few clear ones from the "stock," and proceed to grind down the mouth of each till a plate of glass is found to touch all round, and thus effectively prevent the escape of whatever gas the bottle may be used to contain (Fig. 3). This operation is conducted first on a piece of sheet-lead with emery powder and water, and finished on another similar piece with Tripoli powder and water. The little squares of glass I obtain from the glazier's scraps; before using them as covers to the jars, they must be smeared with a little pomatum or lard.

The few stoppered jars which are found necessary in the laboratory, I purchase from the manufacturer. The spirit-lamp we shall use directly should be purchased too, but it is very easy to make one out of an old pomatum bottle. Here is one of home manufacture (Fig. 4). A small piece of glass or brass



tubing is cut off and inserted in a close fitting cork. The usual cotton-wick is passed through the tube, and the lamp is complete. The only disadvantage of a lamp of this kind is that it allows the spirit to evaporate, whereas the ground glass cap of one in ordinary use prevents this. A retort-stand may be bought so cheaply that it is not worth the trouble to attempt a home-made substitute.

We have now got together all that we require in the preparation of oxygen gas, and we shall, doubtless, be able to manipulate as well with these very simple appliances as with more elaborate and costly apparatus. We next pound up a small quantity of chlorate of potassa, and mix with it a little black oxide manganese, which will serve to keep the particles of potassa separate, and thus facilitate the escape of the oxygen. After introducing the mixture to the retort, we put in the delivery-tube and lute it well with common soap, or linseed-meal paste; fix the flask in the rings of the retort-stand, and let the end (*b*, Fig. 1) of the tube dip into the water of the partly filled trough, just under one of the apertures in the shelf. We fill a jar under water, and upturn it so that the mouth shall be over the end of the delivery-tube, and then apply heat to the retort. We shall soon find the gas bubbling through the water, providing we have no little leakage in the cork. We will let a few bubbles escape, as the first gas given off is always mixed with common air. We apply the heat gently at first, by moving about the spirit-lamp with the hand, and it is advisable not to drive off the gas too rapidly at any stage of the operation, or some mishap is likely to occur. The impure gas being driven off, we may collect as many jars as we require of pure oxygen. See how beautifully it rises through the limpid water in crystal spheres, and gradually fills vessel after vessel! The prisoner is released from his former bonds, and, though invisible, has become a captive again, ready to show us his powers and his almost magic wonders.

Before taking away the spirit-lamp, we must be careful to remove the end of the delivery-tube from the water, otherwise the air in the flask will suddenly cool and the water, rushing in, will fall on the heated material, and probably generate sufficient steam to cause an unpleasant explosion.

We have now prepared several jars of oxygen gas, perhaps a few more than we shall require; but this is a precaution which the student of chemistry will do well to bear in mind, for in spite of every care in manipulation, he will generally have a few failures, and if he does not happen to have a duplicate supply, he will frequently be unable to perform all the experiments he wishes. But before proceeding to experiment with the jars of gas, we must understand the nature of the changes which have taken place in the flask, and led to the evolution of the oxygen. We placed in the retort, you may remember, chlorate of potash and oxide of manganese. Chlorate of potash is a compound of chloric acid (ClO_5) and potash (KO), or, in other words, of chlorine, potassium, and a considerable quantity of oxygen. When we applied heat, the oxygen was driven away from the chloric acid and potash, while the chlorine of the one united to the potassium of the other to form chloride of potassium. The manganese remains unchanged in the retort, its use being to keep the particles of the potash salt apart, and thus allow the heat to act with greater effect.

Let us examine a jar of the gas. It is transparent and colourless; it has no odour, nor anything in its appearance to distinguish it from common air. But let us try a simple experiment, and we shall soon find that it has far more active properties than atmospheric air. Here is a splinter of wood. We will light it and plunge it in a jar of air. We see it burns. Let us blow out the flame, and insert the glowing spark into the same vessel; it grows duller, and will evidently go out. We will now place this faint expiring light into the jar of oxygen. See how quickly it brightens up, and, bursting out in full flame, burns most beautifully. We may extinguish and relight it many times with a small jar of the gas.

Fig. 5.

We will take next a piece of charcoal, and fasten it to the end of a knitting-needle with a bit of thin copper-wire; we pass the needle through a large cork, and then ignite the charcoal in the flame of a spirit-lamp. We must take care, however, to select a piece of charcoal with a portion of the bark adhering, or the beauty of this experiment will be lost. Observe now how rapidly the dull glow of the carbon brightens as soon as it is placed in the oxygen, and how beautiful scintillations of brilliant stars shoot forth in all directions. The carbon is uniting itself to the oxygen in the vessel, and will form with it a poisonous compound, known as carbonic acid gas. The light grows dull again, and finally dies out altogether, showing that there is no more pure oxygen in the jar. We will take out the charcoal now, and try a few other experiments with the gas, which we may suspect has replaced the oxygen. Let us insert a splinter of wood in full flame. Ah! it will not burn in it now, but goes out at once; there *is* carbonic acid present. We will pour in some clear lime-water, and notice the result. After shaking the bottle for a short time, we find the liquid has become milky. This is owing to the formation of carbonate of lime, and proves beyond doubt that carbonic acid was present in the jar as the result of the combustion of charcoal in oxygen.

Our next experiment shall be with a piece of steel, which we will try to burn in a jar of the gas. We will take off the charcoal from the knitting-needle, and replace it by a couple of pieces of old watch-springs (to be obtained for a trifle from any watchmaker), straightened out and secured as before by a bit of copper-wire.

The ends of these we will *heat* and then tip with sulphur till there is a tolerable little ball formed. We must take care in this case that there is a small quantity of water at the bottom of the jar, lest portions of heated sulphur or iron should fall on it and break the vessel. We will now ignite the sulphur, and plunge it carefully, but quickly, into the oxygen. The sulphur burns with a beautiful blue flame, and is rapidly succeeded by the combustion of the steel-wire in splendid scintillations. This is a very nice experiment, and when made with care is sure to succeed. On examining the bottom of the vessel, we find a red-coloured substance, which is oxide of iron, formed by the union of the iron with the oxygen.

FIG. 6.

We will, lastly, try the effect of burning a piece of phosphorus in oxygen. For this experiment we require a small cup affixed to a wire. This we may easily arrange for ourselves. We can either take the needle and cork we have used in the former experiments, or others especially for this purpose, which may, perhaps, be the best plan. We will take a common brass-thimble, and file off the upper half. Thus we obtain a nice little cup, which we can fasten to the knitting-needle with copper-wire as before, and our preparations are complete. We will now find a small piece of phosphorus, about the size of a split pea, taking care, if we have to cut it off a large stick, to do so under water, or the friction may cause it to ignite. We must dry the little piece for our experiment between the folds of some blotting-paper, so that it may not spurt when ignited, and then place it in the small cup. We ignite the phosphorus by means of a heated wire, and plunge it at once into the oxygen. We cannot fail to be struck with the beautiful and intense light produced, so strong that the eye can scarcely bear to look upon it. We see the vessel has become coated with a white substance, which is phosphoric acid, and is the result of the union of the phosphorus and oxygen. If we would see this and similar experiments to the best effect, we should choose the evening for our manipulation when the room may be darkened for each experiment.

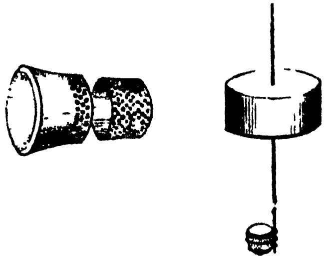


FIG. 7.

Thus have we extracted pleasant occupation and much instruction even from very homely things. And now, good friend, would urge you to try these simple experiments for yourself, and learn that steady an sure manipulative skill without which you will be in danger of making serious blunders and breakages, putting alike your patience and purse-strings to a severe test. Before we part, however, let me give you some further information respecting this wonderful substance. Know, then, that oxygen is the most widely distributed body in the economy of Nature. It is present in rocks, and stones, and trees, in water and atmospheric air, in plant and animal, and, in short, forms the greater portion of all that we see around us. Its livery is a bright red; have you not seen it in the crimson stream that threads the mazy arteries of your body? or perchance you have seen it in the fading leaf at autumn-time, or in the rusty coating of the unused sword, or in the reddish tinge of many a broad acre of our land.

A servant that knows no rest is he. He assists the maiden in making her fire, and fans it into a cheerful blaze; he lights our streets and houses; he sweeps over hill and dale in the zephyr or the whirlwind; he goes down into the depths of the sea, and supports myriads of strange creatures there; he supplies man and other animals with the vital air necessary to their existence; he whistles in through every cranny to fight with disease and death arising from the bad ventilation of thousands of English houses; he fills the vale with the music of the rippling brook, and the beach resounds with his noisy gambols. The foremost he among many servants in carrying on the works of Nature's God.

JOHN JONES.

S. Stafford Educational Union.

MICROSCOPIC ANATOMY.

A KNOWLEDGE of microscopic anatomy can only be obtained by actual dissection. Books are useful only as revealing the labours of others, pointing out paths for us to tread in the pursuit of knowledge, and showing the best means to be used for effecting our ends—an intimate acquaintance with the structure of living creatures. We must, by the labour of our own hands, place before our eyes the actual structures, that we may note their forms and relationships, if we desire to know their uses, and the purposes they subserve in the great scheme of life. By this means alone can we ever obtain an approximation to perfect knowledge of the wondrous creatures with which our great world abounds. It becomes us, therefore, with our instruments at command, to bring them into operation upon such subjects as may be best suited to further our studies. For our yet unpractised hands, the vegetable kingdom will provide objects in abundance, and we may profitably employ ourselves in studying their simpler structures, as a prelude to the more complex organisms of the animal world. More especially as the arrangement of parts is in many cases so alike, that the one helps us to a readier understanding of the other. This will be apparent if we take a piece of garden rhubarb—the leaf-stalk—and slightly boil it in water or dilute nitric acid, to soften the fibres that they may admit of a more ready division and easier display of its construction.

A portion of it being placed on a glass-plate, which, for the sake of cleanliness, may have underneath it a layer of blotting-paper, and fixed in the stage of our dissecting microscope, will show us, under a moderate power, with light reflected from the mirror through the stage, that it is made up of fibres of various kinds all running in the same direction, from end to end. They may be distinguished as woody fibre, ducts, and spiral vessels. The woody fibre constitutes the stringy portion as the vegetable has a more advanced growth. The ducts are for the conveyance of the nutritive juices, and the spiral vessels for the conveyance of air, or other fluids, but more generally the former. It is to the spiral vessel we will devote our attention, as being the analogues of those which play so important a part in the insect world. They have a peculiarity by which they may be at once known. They are hollow, sometimes cigar-shaped (Fig. 1), sometimes

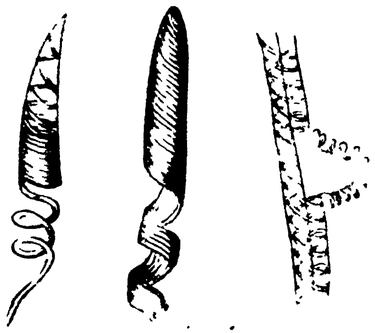


FIG. 1. FIG. 2. FIG. 3.

continuous cylinders, but always having a fibre, either single, or as a flat band running through them in a spiral direction (Fig. 2), hence their name. A closer examination will demonstrate the truth of this assertion, and further show that it is coiled between two membranes, forming an inner lining and outer covering. But we must isolate them, that we may have no doubt about the existence of this spiral fibre; and unless this be the ruling principle in our anatomical studies we may constantly be coming to fallacious conclusions, and fostering the publication of erroneous statements—a system which has done much to retard the progress of true knowledge.

To effect the separation of these spiral vessels, our mounted needles, straight and bent, will be very useful. A pair of these, with a camel's-hair pencil, will be all we require. Taking one in each hand, holding them lightly but firmly between the finger and thumb, somewhat as we hold a pen; we must carefully tear asunder the fibres, washing away all the extraneous matter with the pencil until the spiral vessels are left quite clean. They may now be permitted to dry partially, after which the membrane may be ruptured by the needle, and the fibre uncoiled and drawn out. The number of threads in each spiral will vary in different vessels, and even in the same vessel will sometimes show isolated rings; while in a third may be plainly seen two fibres coiled in opposite directions, thus giving an appearance as seen in Fig. 3. Other vegetables will show a flat ribbon of several fibres, neatly laid side by side with a precision that cannot fail to excite admiration in the well-arranged mind that loves order, and feels a charm in studying the beautiful works of Nature. It might be interesting to consider the morphology of these vessels, to learn the process by which they have been formed from a coalition of cells, but this belongs to vegetable physiology—a subject we may by and by touch upon more appropriately, in our studies of vegetable life.

From these forms of ducts or spiral vessels, which we have described, there are various departures, but the object in all is alike. Plants must breathe as well as animals; there is, therefore, the same or a similar provision for rendering these air passages elastic, that they may admit of easy flexure, and preserve a perfect tubularity for the flow of the life-sustaining element. And how could this have been more beautifully and effectually provided for than as it is? Man knows not, but gives his silent tribute of praise, by adopting the same plan whenever he desires to attain the same end.

Spiral vessels in plants are the analogues of the trachea in insects (Fig. 4), and of air-passages (Fig. 4A) in animals at large, and the same kind of structure may be clearly traced in them both.

In the insect world they play a most important part. Branching and ramifying in every direction, their minute tubes may be traced to the end of the extremities, even

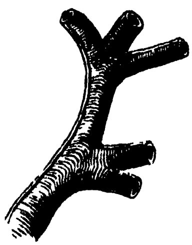


FIG. 1.

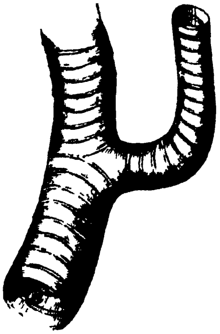


FIG. 1A.

through the wings. The need for this extended system of breathing-tubes will be better understood when we have learned more concerning the structure and economy of these little wonders. It was with this in view that I first drew your attention to these air-vessels in plants, because they are more easily dissected out, and therefore more properly fitted as our first lesson in Microscopic Anatomy. We are now prepared to enter upon the study of insects. Not as their structure might lead us to an entomological arrangement of the different kinds, but purely anatomical, though we have an idea that a more perfect system might result were their physiology and anatomy more closely looked to. The value of such a course is seen in the , which, once regarded as a fish, is now classed with mammals.

There is no class of objects so readily obtained, that offer so many points, and have so great an attraction for the microscopist as the class *insecta*. Nature, in the plenitude of her resources, seems in these to have grouped together so many wonders, and so many beauties, that we know not which most to admire, the wisdom that devised the plan, or the handiwork of the great Architect. As we contemplate their external forms, painted in glowing colours of rainbow-splendour, or studded with points of light that seem like heaven-born stars, or gems from earth's deep treasury, nor less so in those of sombre hue and strange exterior, we realize the poet's words when he sang—

> "Figured by hand divine, there's not a gem
> Wrought by man's art can be compared with them."

And when with curious eyes we lift the veil and look into the tabernacle of life, we feast our eyes on sights so marvellous, organs so nicely wrought, and nerves so delicately strung, it wakens up our prying propensities, and stimulates us to labour. Yet only as we calmly study them, apart from the enthusiasm of every lover of Nature, can we hope to understand why such differences exist, and what can be the office of structures so dissimilarly formed to those which our every-day learning has made us acquainted with, as they exist in our system. Are they not destined to play a part in the great world of life—a part we cannot play? Without doubt they are as important to our well-being as the flowers that bloom. Each forms a link in the great chain of life, from which, if one were struck, Nature herself would rue.

As spring advances, hosts of insects come trooping into life. Then we may have our choice of subjects for the purpose, but at this time of year we must content ourselves with such as we can find. We have taken for our present dissection the cockroach,* which, alas! in this part of England is far too plentiful for our comfort. These have been our companions in the long winter evenings, and have helped to make the time fly so rapidly that we have not been cognizant of the approach of the small hours, until the fading of the fire in the grate has made us feel a chill that has waked us up from our studies to seek our bed. We have one in our trough, which has been previously immersed in alcohol for

* *Blatta orientalis*, from Greek verb "to hurt."

a few days to harden him; this previous preparation is one of the great secrets of success. Its action is the withdrawal of the watery particles, which makes them soft and flabby. We have pinned him to the wax lining of the trough, on his back, the pins passing through the wings to keep him steady, and he lies covered with water, until the trough is nearly full. We will drop into the arm of our microscope the lowest-power lens, arrange our lamp and condenser, so that it may throw a good light on to the object, and with our finest scissors, assisted by the forceps, carefully cut away the abdominal plates, as near the sides as possible, making sure that we do not lacerate the viscera. This being accomplished, the nervous system (Fig. 5) presents itself, its position being abdominal. In this insects differ from animals, and in lieu of the nervous cord, being inclosed in a bony canal, it rests upon the viscera; all being inclosed in an external skeleton or coat, which is not bony, but formed of a substance called chitine. The nervous cord may be removed either in part, or wholly, by cutting away the legs, and opening with care the thorax and head. This implies a greater delicacy of manipulation than can be acquired without some practice. It will, however, answer our present purpose if we remove a small portion, and we shall be assisted in our study if we place it in a watch-glass containing a little acetic acid and alcohol, which will further harden it, and render it more transparent.

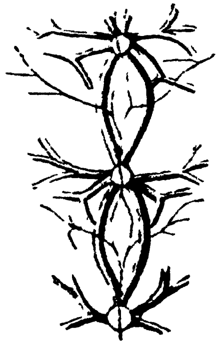


Fig. 5.

If it be now transferred to a plate of glass, having a shallow cell ground out of its surface, which may be filled with water, and plased under a second power—magnifying twenty-seven diameters—it will be seen as represented in Fig. 5. At intervals in its length there are enlargements. These are termed ganglia, which are usually thirteen in number, but the last two being confluent, there appears but twelve. They correspond to the segments, and from each are given off fibres, which run to various parts; one set going to the wings, another to the legs, others to the antennæ, to the eyes, to the mouth, etc. The cord which connects these ganglia (or little brains) is double, and corresponds to the same structure in vertebrate animals, though there it appears as a single cord, until closely examined, when its double structure is clearly apparent.

These cords and ganglia are the origin of the nerves of motion and sensation. A careful search will discover another set of nerves—the respiratory. They consist of a very slender thread placed on the medium line of the ventral cords, dividing below each ganglia, where it seems to spring from the angle formed by them and the double cord.

This system may be seen by carefully separating the two cords with very fine needles, and then covering them with a piece of thin glass, having a little fluid inclosed in a ring of thin sheet-lead, to form a flat cell. A somewhat higher power is needed to get a good view of the object, and is best attained under the compound microscope, but with the single one may be satisfactorily demonstrated. The anterior portion of the cord shows other ganglia, and the optic and other nerves may be made out.

On either side of this cord, the main trunks of the trachea are placed, having small branches diverging in every direction, and larger ones running outwards to the spiracles, of which there is a pair on each segment connected transversely. It is difficult to get a good view of these openings or gratings—perhaps the easiest plan is to immerse a whole insect in olive-oil, and after it has soaked for a few hours, to view it with a good light as an opaque object. The spiracles, with the trachea connecting them in pairs, may then be easily seen; and if an abdominal plate be removed, taking care to sever the trachea with the scissors, they may be submitted to a power of 400 diameters, and the spiracles seen as depicted in Fig. 6.

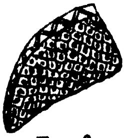


Fig. 6.

Probably, also, the spiral fibre of the trachea will be drawn out, and demonstrated as a flat band of four strands, as in Fig. 2. Our space will not permit us to go further into the respiratory system which these trachea form, or we might show the need for so extended a plan of aerial communication as all insects have. It must suffice to say that it depends upon the absence of lungs, gills, or branchia, as we find in other living creatures, and also on the peculiarity of their circulatory apparatus, etc., in which there are no veins.

This brings us to notice the nutritive system, and we shall need frequent recourse to our washing-bottle, to remove the fatty matters, which otherwise obstruct our view; but at all times we must direct a very gentle stream of water upon the object, that we may not displace or rupture any delicate parts.

Cockroaches are omnivorous, and their mouth is armed with jaws that are ever ready to appropriate whatever comes in their way —woollen stuff or leather, animal and vegetable substances, even the ashes from the fire-grate, are alike palateable. If the thorax and prothorax be laid open, we can easily trace the course of the œsophagus (which is lined with villi or setæ), until it dilates into a crop, or, as it is better termed, the chylific stomach (Fig. 7, *a*). Opening into the œsophagus on each side, a little below the mouth, are the salivary glands (Fig. 7, *b*). They consist of a series of small sacs, lined with secreting cells; the sacs opening into ducts, forming a long mass, not unlike a bunch of grapes, excepting that they are disposed in a layer, rather than a roundish mass. The action of acetic acid renders their cells very distinct. The chylific stomach has three coats, an outer or muscular, a middle, or glandular, and an inner, or villous. The muscles are variously disposed to give it motion in several directions. Acetic acid renders their nucleated

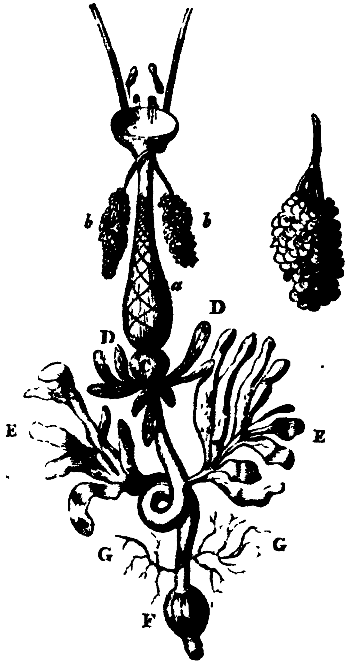


Fig.

structure very distinct. The glands probably secrete a fluid for its lubrication. The inner membrane is rugose, and beset with villi, which are longer on the ridges, covering also the irregular hexagonal pits, of which it is

Fig. 8.

Fig. 9.

full (Fig. 8). They are supposed to correspond with the gastric follicles of animals.

At the lower end of the first stomach, from which it is separated by a valve, is placed the gizzard (Fig. 7, c). It consists of a strong muscular coat, inclosing a series of

teeth, and ridges of a brown colour, hard and horny, usually five in number, sometimes six. They are moved upon each other by powerful muscles, which most effectually comminute the hardest particles that are subjected to their action.

To get an accurate knowledge of its struc-

Fig. 10.

ture, it must be slit open with the fine scissors. (Fig. 10), and soaked for a few days in caustic and potass. After being well washed, it may be mounted in fluid or balsam. Passing downward, we have a second stomach, with its cæcal (Fig. 7, D) appendages—eight in number. These are apparently glandular—indeed we have little doubt but that they are the rudimentary pancreas. That they are not mere prolongations of the stomach is certain from their contents, acetic acid showing a layer of cells on their inner surface. Yet they may be reservoirs for the storing up of the chyme. Below these is the large intestine, having on each side a knot of yellowish tubes (Fig. 7, E E) opening into it. They are very numerous and lengthy, and are developed into several large lobes and lobules, all of them containing cells, and a fluid in colour like bile. They are the representatives of the liver of animals. A portion submitted to a magnifying power of 400, shows, after treatment with acetic acid, cells as depicted in Fig. 11, each filled with biliary globules. The remaining portion of the nutrimental canal may be called the intestine, which is usually filled with

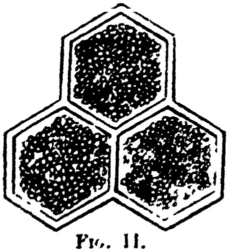


Fig. 11.

matter; at its lower portion there is a dilation of a somewhat globular form, the cæcum (Fig. 7, F), its internal surface having six ridges covered with glandular warts.

In close proximity to the alimentary tube, we find the lining membrane and urinary organs. The secreting portions of the former (Fig. 12), reproductive organs and rudimentary kidneys (Fig. 12, *b*), are elongated and somewhat pear-shaped lobules, having an outer and inner coat, the inner one lined with cells, and the tubules are filled with germs in every stage of development, as seen in Fig. 12, *c*. These vessels are united into two bundles, and discharge their contents by two ducts merging into one, by

Fig. 12. (Magnified 600 diameters.)

which they are connected with the excretory portion (Fig. 12, *a*).

These in the female (Fig. 13), and which may be distinguished from the male (Fig. 13A) by the absence of wings, present at this stage of our labours but few difficulties. The

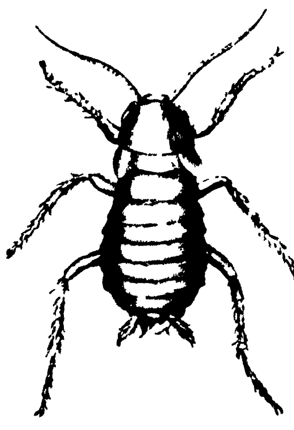


Fig. 13.

greatest, perhaps, is in making out the exact structure of the ovaries. A reference to Fig. 14 will give an idea of what we are to search for, and assist to an understanding of the various parts. The ovaries are six in number (Fig. 14, *a*), and are attached by their anterior ends to the covering of the back, on the first or second segment; from these the eggs pass downwards, through other larger sacs, whose glands secrete and cover them with a layer of chitine, which forms

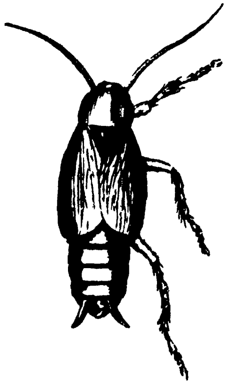


Fig. 13A.

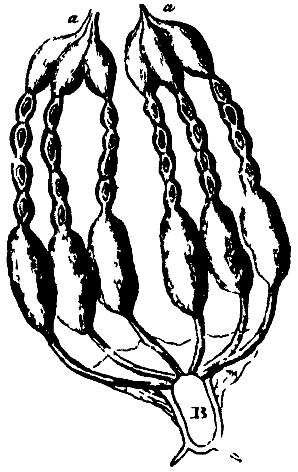


Fig. 14.

the cocoon, but not until they have been fertilized. The most curious part is the regularity with which these eggs are laid, and the way in which the beautiful little box is constructed which protects them until the larva are ready to issue forth. We suppose each egg to be perfectly covered with its envelope ere it reaches the last dilation or cloaca (Fig. 14, B); there they are arranged side by side, and a perfect union of the several portions is effected. This is assisted by the shape of the cloaca; while the septa that are formed by the sides of the eggs that are in contact, remain as so many stalls.

Fig. 15.

An attentive examination of these cocoons (Fig. 15) will, we think, confirm our idea. When first expelled from the parent they are soft and light in colour, and are carried about by the female until they are hardened by the air. In this she is assisted by two appendages on the under surface of the body attached to the last segment, and when the time arrives she fastens them in a warm spot, and commits them to the world. The larva are very like the parent, except in their colour, which is a light amber brown, and the sexes are not distinguished by wings, being alike absent in both. The urinary organs (Fig. 7, G G), in both male and female, open into the alimentary canal near its termination. They are a series of tubes having bifid

Fig. 16.

extremities (Fig. 16) filled with a white substance, which gives to them so marked a feature that it is next to impossible to overlook them. If there were any doubt about their functions; the fact that we can detect within them large collections of crystals of uric acid would at once remove the doubt. These crystals (Figs. 17 and 18), under the polariscope, show all the properties of those which are obtained from other sources. In the male we have found urate of soda.

The muscles by which the various motions of insects are performed are the most easily seen of all their structures, and far surpass in number and power those which are found in any other class.

Lyonnett counted more than 4000 in a caterpillar. There are two kinds of muscles, the striated and non-striated. The striated are those chiefly concerned in voluntary motion, as running or flying, etc. The non-striated are termed organic, and give motion to the stomach, and other organs which are

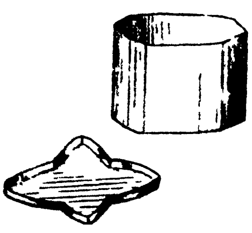


Fig. 17. (Magnified 200 diameters.)

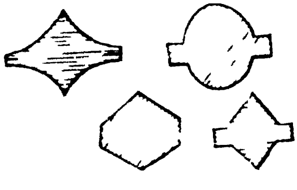


Fig. 18. (Magnified 200 diameters.)

not under the control of the will of the creature.

Their structure is readily seen by placing a portion on a slide with a small quantity of acetic acid, covering it with a piece of thin glass. Its striæ, but more especially its nuclei, are rendered more distinct. These nuclei are alike in the striated, *b*, and n[illegible] muscles, *a* (Fig. 19).

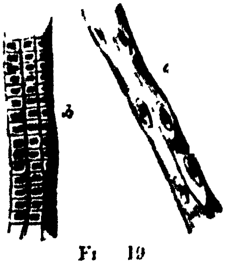


Fig. 19.

The circulatory apparatus in the cockroach does not present any peculiar features. Like that of other insects, it consists of a dorsal vessel (Fig. 20), divided by valves, forming one long contractile heart, by which the blood, which is almost colourless, is propelled, and to which it is returned through openings in the sides of it, after having meandered through the lacunæ, or interspaces between the several organs.

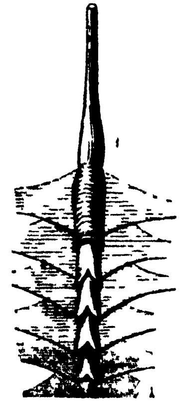


Fig. 20.

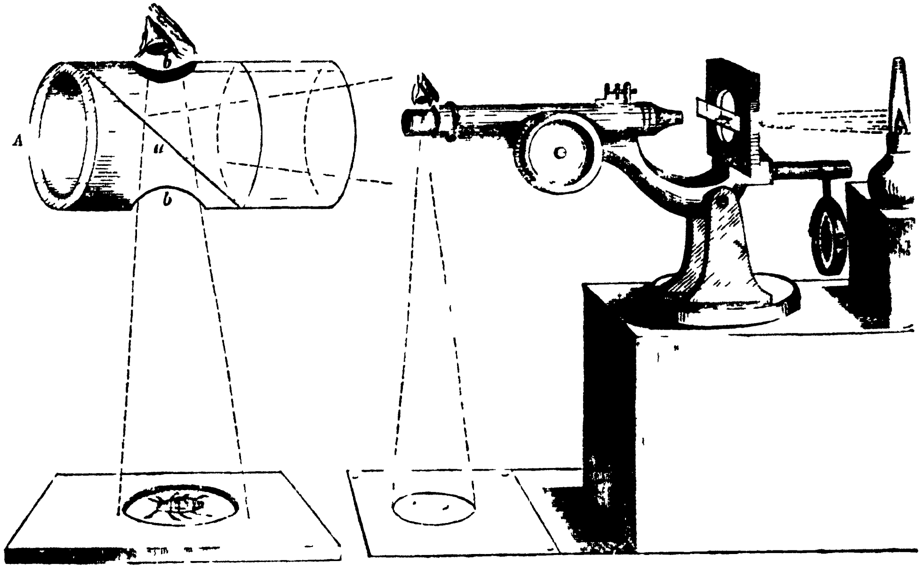
The most delicate management is necessary to obtain a good view of this dorsal vessel; perhaps the best plan is to remove all the viscera by washing with the syringe, when it will be seen closely connected with the muscle of the back. The form is represented in Fig. 20, with the muscles which retain it in its place.

We must not pursue this subject any further, as it would lead us into anatomical studies too abstruse for the young student, for whose behoof we write. As he progresses, authors eminent in this department may be consulted with great advantage, but not to the exclusion of individual labour, which, we repeat, is one of the essentials to success.

The best means of preserving the results of our labour, and fit them for the cabinet, is to mount them in cells constructed with rings of thin sheet-lead. These may be readily punched out with a pair of brass-tubes having a sharp edge.

They should be cemented to the glass-slide with asphalte varnish, after being flattened between two pieces of plate-glass. When the cement has become quite hard, they will be ready to receive the object. The preservative fluid may consist of camphor-water, containing a small proportion of creosote. Their fragility leads us to recommend that drawings should be made of worthy objects as soon as they are mounted. To facilitate this most fascinating feature of Recreative Art, we give the plan with which we have been most successful.

The camera (Fig. 21, A) is fitted to the eye-piece of the compound microscope after removing the cap. It may be readily constructed from a piece of gutta-percha tube of the required size, and two inches in length. A square of thin glass, *a*, of the kind used for covering objects, is to be placed in it at an angle of 45°, and retained in its place by two wire-rings. On opposite sides of the tube two holes, *b b*, must be cut, that we may see fairly through the glass. The other end of the tube is to be closed either with a cork or gutta-percha.



The microscope being arranged as above, and with a lamp to throw the light through the object-glass, the object placed firmly on the stage, and the camera adjusted, we shall have projected on a sheet of white paper a magnified image, and with a pencil we may trace an outline, afterwards to be filled up by hand. The advantage of this camera over that of Dr. Wollaston, is that it gives us as good a view of the pencil-point as of the object to be sketched, if the paper be nicely illuminated. These drawings, if surrounded with a black circle so as to show on a white ground, will serve as pretty illustrations for a *Microscopic Journal,* which every one who studies this charming science should keep, and therein record every observation which is made. It will form no mean addition to a library, and no small source of pleasure after a twelvemonths' labour. For the want of such a plan numbers of valuable observations have been lost which might have enriched our knowledge, and graced the pages of our scientific annals.

Let us not think our humble labours valueless, but ever keeping truth in view, strive to aid the progress of science by a diligent and persevering search in the wide field of Nature, which teems with beauties made only to delight the eyes of her lovers.

Hull. T. ROWNEY.

TYPICAL STRUCTURE OF PARASITIC FUNGI.

In our last article (p. 189) we examined the lowest forms of the tribe of Fungi. Nothing can be of more simple structure and form than those little globose plants; indeed, we are here at the starting-point, the foundation, as it were, of all creation; for if we examine the lowest forms of animals, vegetables, or minerals, they have the spheroidal shape. In the higher and more complicated structures they deviate from spherical outlines: or if we look into the heavens, we there find that all her glorious orbs are, to our perception at least, spheroidal; so that whether we look into the ultimate atoms or the grander forms of creation, we see the globose form. It is, therefore, a matter of great importance to the practical naturalist that he should be well acquainted with the primary form; he will see that the simple globose cell of the Uredo is our starting-point in the examination of the Fungi. Were he to select the Algæ or Confervæ for his investigation, he must begin in like manner, and he would find that the most simple forms of that tribe are found on damp walls, palings, and that they are globose, and very similar in structure to the Uredo we have described. So also in animals, the lowest forms are so simple in their structure that it is difficult to know, with our present knowledge, where animal life begins, and how to distinguish it from vegetable; but to pursue further these diverging, these radiating lines, as it were, from the simple cell, is not our present object, but to confine ourselves to trace up from this point some of the more complicated structures of the Fungi, and show the gradual steps of their development.

The pe. :-shaped form and peduncle of the *Uredo saliceti* brings us into close connection with the following genus, *Puccinia*. But it will be seen that the *Uredo* is only single-celled, while the *Puccinia* is two-celled, one placed above the other.

The name *Puccinia* is from *Puccini*, a Florentine professor. The genus is composed of numerous species, and is found upon the leaves and stems of many living plants, in various-shaped clusters rising from beneath the cuticle or outer skin of the plant on which they grow, and by their expansion they elevate, and at length burst through it, the edges of the cuticle forming the border to the little clusters, which are of various colours, as white, red, yellow, brown, or black, and to the naked eye look like little heaps of minute granules.

The genus is an interesting one, not only as showing the connecting link with *Uredo* in the chain of development of the genera, but from the circumstance of one of the species being found upon the leaves and culms of corn and grasses; and when it grows in abundance, as is sometimes the case, it is very injurious, for it greatly weakens the plant on which it grows, and deprives it of much of its nutritive properties. This species is the *P. Graminis* (Persoon), and is commonly called mildew; it forms small pale scattered spots, of an oblong shape, which frequently become united into long parallel lines, changing from yellowish brown to black. Fig. 1 shows a part of the culm and leaf of grass, studded with the linear-shaped clusters of the *Puccinia*: *a*, portion of the stem slightly magnified, showing the granular appearance of the clusters and elevated cuticle, forming the border, some parts of it entire, others splitting and falling away; *b*, different forms of the sporidia, showing their two cells elevated upon peduncles, and filled with a mass of minute ultimate sporules.

The Sweet William, *Dianthus barbatus*,

is an old and favourite flower of our gardens. Its leaves are often, in the latter part of the year, found to be more or less covered over

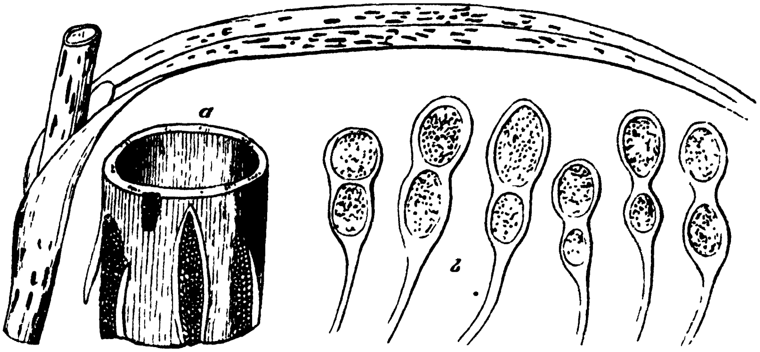


Fig. 1.

with yellow blotches. If these are examined on the under side, there will be found small,

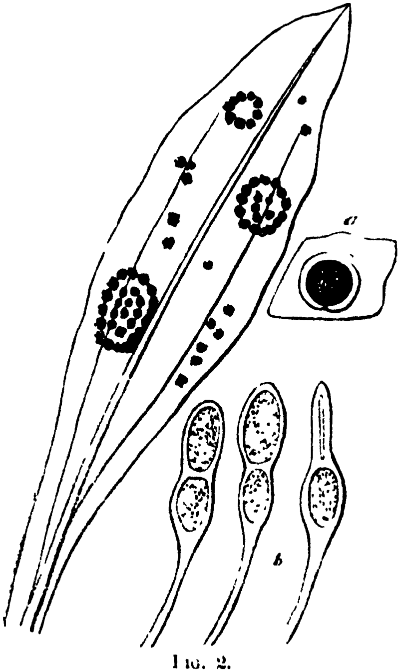


Fig. 2.

round, or oblong granular clusters, scattered and single, or united into circles similar to those represented in Fig. 2. When young they are pale, but in an old state they become dark brown; this is the *Puccinia lychnidearum* (Link.), and is found upon various plants belonging to the same order as the Sweet William. A pocket lens will show that these clusters are found beneath the cuticle of the leaf, which they elevate, and at length burst, the thin skin of the leaf forming a border around the granular-looking mass of the *Puccinia*, as shown at *a*. When these are seen through the higher powers of the microscope, they are as represented at *b*, formed of two equal or unequal-sized cells, one above the other, and filled with a mass of minute granules, the ultimate sporules, or seeds: one of these shows the upper cell collapsed, from having discharged its ultimate sporules, the other cell being still full of them. Fig. 3 is another illustration of this numerous genus; it is the *P. polygonorum* (Link.), and is found upon the leaves of various species of *Polygona*: the little yellow sori are either scattered or crowded together into orbicular patches; each little cluster is surrounded with a pale membranous border, *a*, which is more distinctly seen as the *Puccinia* become darker brown, and often black; *b* shows them as seen highly magnified.

These illustrations will be sufficient to make the student acquainted with the tribe

Hypodermii (named from two Greek words, signifying beneath the cuticle); sporidia free or stipitate, springing from beneath the cuticle of living plants.

Great attention has been given, and much written upon the growth of those little parasitic Fungi growing upon corn and grasses, as we have before mentioned, and experiments have been made to show how far they are injurious to health. Quantities of those species, growing upon corn, have been collected and taken in repeated doses on several successive days, without producing the slightest derangement or inconvenience. It has also been given in large quantities to fowls, but without producing any injurious effects. Neither have men employed in thrashing out corn affected with bunt suffered any ill effects from it, beyond a slight cough or sneezing, though the atmosphere in which they worked for hours, and on successive days, was loaded with sporules, and they must have inhaled and swallowed them in vast numbers. It is reported, however, of one species of *Uredo*, that grows upon the common reed, that it has irritating properties, and that persons who are employed in cutting them when the *Uredo* is abundant, are liable to be affected with headache and inflammation, and swelling of the skin of the head and face (probably erysipelatous), and acute inflammation of the bowels.

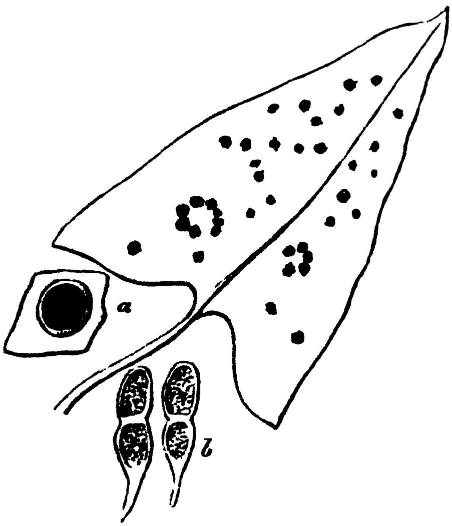


Fig. 3

We now pass on to the next tribe, *Sporidesmiæ* (from two Greek words, signifying *seed* and a *chain*); sporidia chained together into flocci (filaments), at length free. The connection between the tribe that we have described and this we shall find very simple; in fact, only a step. In the genus *Aregma* (from two Greek words, signifying *without an opening*), the sporidia are attached to each other in a club-shaped form, elevated on a pellucid peduncle or stalk.

In speaking of *Uredo ruborum*, it is mentioned that the coloured spots upon the leaves of the bramble are caused by the growth of other fungi besides the *Uredo*, and very commonly on the same leaf with the *Uredo* will be found small but elegant black granular clusters, scattered or crowded together, and looking like patches of soot, this is the *Aregma bulbosum*, Fries (Fig. 4). It is more elevated and distinct than the *Uredo*,

Fig. 4.

as well as being of a different colour. One of these clusters is shown slightly magnified at *a*, but if a portion is placed under a high power of the microscope, they will be seen as at *b*; the sporules entire, club-shaped, the top dark brown, almost black, usually formed of four sporidia united together, the upper one with an obtuse apex, the peduncle pale, pellucid, and swollen at the base in a bulbous manner, and formed of two membranous tunics. The sporidia are so dark-coloured that it is difficult to see the septa between them, but by moistening them with a drop of tincture of iodine they become more distinct. In maturity the sporidia separate from each other, are single-celled, and filled with a mass of ultimate sporules, and the outer tunic is frequently rough, with elevated points. Rose leaves are frequently studded over on the under side with clusters of *A. micronatum*, Fr. (Fig. 5). A small cluster enlarged is shown

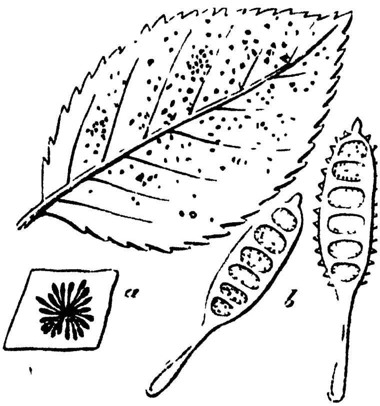


FIG. 5.

at *a*; these highly magnified, as at *b*, show their club shape, with a terminal point. It is formed of five to seven sporidia, and is generally rough, with elevated points, and is dark brown, almost black; but the peduncle is colourless, more slender, and less swollen at the base, than the last species. Raspberry leaves, both wild and cultivated, in the autumnal months, are frequently infected with a species of this genus, the *A. gracile* (Grev.) The leaflet is similar to that represented at Fig. 5, but when the little fungus is examined, it will be seen as at Fig. 6, club-shaped and black, generally formed of eight sporules, sometimes of a less number, and occasionally only one; it has a longer, more acute apex, and the peduncle is longer, more slender, slightly swollen at the base, where it forms a cell, which contains globose granules, larger than those contained in the sporules. What office these bodies perform in the economy of the plant is only a matter of conjecture; it may be the same as stamens in flowering plants.

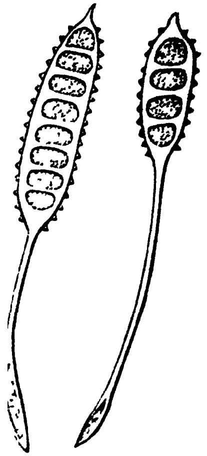


FIG. 6.

The elegant forms of these little plants can only be appreciated by examination; they

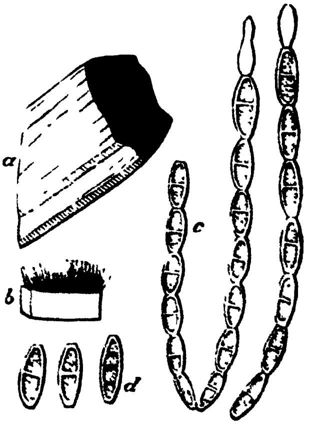


FIG. 7.

are the jewels, as it were, adorning the matured or waning leaf, and to the manufacturing jeweller and his craft they are indeed mocking-bird, all of them near relations of our sable herald, who combines all their several qualities, and has yet some others to distinguish him from them all.

The most distinguishing characteristic of our bird is his raven colour. The whole plumage is of pure velvety black, the eyelids are orange, and the "orange-tawny bill" is as Shakspere describes it, and not "golden," as described by smaller bards. The female is very distinct, and may be recognized at a considerable distance by the brownish black of the plumage, and the subdued yellow of the bill, which is only two-thirds yellow, the smudgy mixture of red and brown with undecided black on the breast, and by her larger size. In habit the blackbird is the shyest of all our native songsters, though it is a constant associate of man, never builds far from the town or village, is very rarely seen in really wild and unfrequented places, but loves the *rus in urbe,* and combines the enjoyments of human society with as much of the picturesque as can be had as a corollary. Hence though the borders of lakes, and muddy streams in thickly wooded countries, are places where the blackbird is pre-eminently at home, especially if the garden croft or woodyard be near at hand; yet in the suburbs of London it is one of the most plentiful of all the songsters. And here at Stoke Newington they literally swarm in the gardens, and build wherever a retired nook offers the seclusion of a poll of ivy, or a neglected corner rank with overgrowth and underwood. I expect always to hear the blackbird on the first of January, but it is rarely that he greets us with any other than his harsh note of alarm at that season, as, startled during his search for the morning meal, he takes his low flight through rather than over the trees, presently followed by his mate, who adds her chir-ra-ra-ra-ra-rath to the complaint of her frightened lord. Now here is a moot point in the blackbird's history; do they pair seasonally, or for life? Wood observes that many remain in pairs throughout the winter, and is of opinion that they pair for life. I have them in my garden all the year round; shy and retiring during late summer and autumn, but bolder and more numerous all through winter and spring, and it is one of our chief delights to watch them and the thrushes searching about on the lawn, foraging in the hedge, and when a fat snail has been bagged, hurrying to the gravel-path, to reverse the children's rhyme, by first beating him "black as a coal," in order to make him come out of his hole. The thrushes occur singly till paired, the blackbirds go about two and two, and the rule of their presumed marital life appears to be, one watch and one work; for either the male or the female is ever on the alert for the slightest sound of danger, while the other tugs at an unhappy worm, or scrubs amongst the litter for a prize. That some blackbirds pair for life is, I think, past a doubt, but it is certainly not the rule; for many single birds are to be seen in the autumn, and occasionally small quarrels occur between these and settled pairs. There is a popular notion that some blackbirds remain in celibacy the whole year round, but there are no observations on record of a sufficiently reliable character to strengthen the idea.

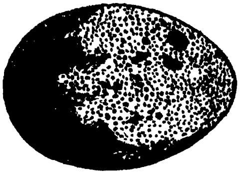
In the domestic history of this bird there is one feature, which we know not whether to characterize as a sign of confidence or stupidity, and that is the careless way in which the site for the nest appears to be selected. Here is a shy bird, which scuddies through the fence, crying as it goes, in the unmistakable language of alarm, yet it will rear its domestic altar in a pile of faggots in the busiest part of a cottage-yard, in a knot of ivy close beside the bedroom window, in the fork of a holly skirting the garden path, and even under the thatch of a bee-shed, where the master makes daily visits to give attendance to the bees. We must conclude that the blackbird has a large development of the organ of fear, and a deficiency of the organ of caution; certainly there is little art or cunning in its nature, whether we watch its movements in unfettered freedom, or in the narrow compass of a chamber cage. The nest is very uniform in character, and well compacted in structure. The outer circumference is generally formed of small twigs, bents, and scraps of fern and lichen; the inside is lined with finer scraps of grass and oss, and plastered very neatly with mud. chosen for their nests, and which I need hardly say are, when thus discovered, held sacred and secret. No marauding hand disturbs them here; my neighbours are all enthusiastic in encouraging the domiciliary visits of the singing people, and they enjoy a large area of well-wooded gardens, in which there is no trap set and no gun ever heard. It is when the nest is finished that the sable chieftain pipes his most melodious lay. Then

Nest of Blackbird.

The bin in which I keep moss for potting purposes in my garden-shed, is visited by birds of all kinds that build among the gardens near, and scarcely a day passes during January and the early part of February, but some of the blackbirds of the district make a sudden departure from the tempting store on being alarmed by my footsteps. But by quietly watching their visits to this magazine, I can track many to the sites they have

it is you hear the "oosel cock" in the full strength of his mellifluous song. His favourite place is the highest branch of a pear or poplar, close beside the nest. He does not merely soothe the partner of his bosom—he carols to her such a roundelay as makes the woods ring again; he is boisterous in his mirth, for is not food plenteous, and there are five eggs laid. To hear the song aright the bird must be free, the strength of his voice is such that it needs dilution in the broad atmosphere, and to hear it in perfection find yourself a seat beside a purling stream in a copse hard by a village or a cluster of homely cottages. The bird is happy, how should we be otherwise than happy while rejoicing with him in the rapid change that is passing over the face of Nature. Never does the blackbird sing the same song twice; you hear repetitions of notes, but always in a new arrangement. You can never be mistaken that it *is* the blackbird; yet you cannot recall the shape and tenor of the song, as you can that of the robin or the chaffinch. But observe how our minstrel is affected by the moods of the season. From the beginning of March to the end of May he is at his best as to fulness and fluency of song. During that period there comes a sudden burst of real summer weather, and the blackbird is silenced by the heat of the sun. In the midst of this heat there comes a smart spring shower, and as if by magic the woods and gardens resound again with his boisterous flute-music. So, as the season advances, the ousel hides himself, none can say where, during the heat of mid-day; but as the sun goes down he breaks out again with marvellous freshness, evidently fortified by good living and mid-day sleep. But the morning is the time to hear him in his greatest perfection. He loves the dewy hour, and from the summit of his favourite tree tries all the echoes of the village for a full half hour before a single note of the thrush —his boon companion—is heard. If some of the folks who shoot blackbirds by the dozen, and justify the barbarity by alleging that they thin the fruit crop, were to rise at a proper hour to observe the habits of this haunter of gardens, they would see enough of his depredations among the gardener's enemies, to convince them that if he is not to be respected for his song, he ought to be for his services. As a destroyer of snails, every blackbird more than pays the gardener for whatever fruit he may destroy.

The ousel is prolific; the eggs usually number five, and there are generally two broods where the birds remain unmolested. The eggs are various in colour and markings. The Rev. F. O. Morris, in "Nests and Eggs of British Birds," describes a number of curiously marked eggs, all known to be from nests of the garden ousel; some of which resembled the eggs of the starling, some were obtuse at the small end, and others exhibited colours very far removed from the type. The usual colour is dull light blue, or greenish brown, mottled and spotted with pale reddish brown, the markings being obscure at the larger end, where they sometimes form an obscure ring.



Egg of Blackbird.

Our songster is a general favourite as a cage-bird. Yet, though when well trained and well kept he endures confinement with much patience, the inducements to keep caged blackbirds are not very many or very strong. He is a most ungainly inmate of a cage. His great legs sprawl about as if he had forgotten how to use them. With the utmost regard to cleanliness, the blackbird can hardly be kept clean one whole day through, and then the song is too loud to be enjoyed in a room, and when put outside the window it is a really different song to that which he sings when enjoying his native freedom. Still, for those who do like it, there can be no greater sin in caging the ousel than any other bird; and a few words as to treatment may be useful. I have trained and taught a great many blackbirds, and always succeeded in the exact proportion in which I sought to meet the bird's natural requirements. They must have roomy cages, a constant supply of fresh prepared food, plenty of water, occasional treats, and means of bathing daily. Let us take the several points *seriatim*.

Birds brought up from the nest are the

best if they are to be taught tunes, but bat-folded birds are the best if required to sing their natural notes. If you take nestlings in hand, bring them *all* up with care, and when they are *all* strong enough to fly, choose those that are darkest in colour and most distinctly marked; but bear in mind that a nestling invariably has the wing-primaries brown until after the first moult. Set the others at liberty. The food for these young birds at first should be white bread soaked in hot milk, and a little raw beef minced fine, and mixed with the bread. Feed them every quarter of an hour at first by means of a wooden skewer. After a week feed them every half-hour, and very soon they will learn to help themselves, and must have proper blackbird food. Take a piece of crumb of stale white bread and grate it fine; take hemp-seed of the same bulk, scald it and pound it well in a mortar; add the same bulk of barley-meal, and mix it all together. This is the staple food I use for ousels, thrushes, robins, and larks, but for each an addition is made as needed. The convenience of having such a staple is, that it need only be prepared once a week, whereas if milk or meat be used as an ingredient, the food must be prepared every day. In feeding, a little minced beef or mutton may be added, a few garden snails will always be accepted eagerly, but a young bird cannot break the shells of large snails, so they must be broken for it unless small snails can be obtained. Worms, insects, potato, and almost anything from the table, if not salt, may be given, and will be acknowledged with thanks in a loud "tac."

The cage for a blackbird should be of the form here represented. The bars in front to be of wood, the perches square, and there be a bath to fit to the open doorway. Some birds I have had have been many months becoming thoroughly tame, and the process of cleaning the cage caused so much plunging and sprawling that the bird invariably bled at the nostrils after the operation. In such cases I have taken them in hand myself, and shown how, by using judgment and kindness, such cruel results might be avoided. A spare cage baited with a meal-worm or a bit of cheese, was placed so as to form a second chamber to the cage containing the bird, that is, by opening both doors and placing the two cages close togehter. Sambo

immediately flounced in after the dainty, the bath was attached to the door of his temporary domicile, and while he splashed himself his own cage was got ready for his reception for the day, and he was coaxed back into it in just the same way as he was coaxed out of it, and the arrangement was comfortable for all parties.

As to teaching, you may do almost anything with a nestling, according to the amount of your skill and patience. This bird is naturally imitative, it is the British mocking-bird, and will acquire many curious utterances by self-culture. Mr. Kidd relates some very curious stories of blackbirds in his own collection, some of which articulated words distinctly, and one precocious scapegrace took lessons of a potboy, and saluted his master with "O crikey!" At liberty this bird often picks up lessons in the farmyard, and has been known to imitate the crowing of a cock, accompanied with a flutter of the wings, to great perfection. Mr. Wood says he has often heard it imitate the cackle of hens. If to be taught to whistle tunes, the selected birds must hear as few other sounds as possible; they may for a time take lessons together, the tune being piped to them several times a day. As soon as they begin to attempt it themselves, which they will do in a low recording tone, they should be separated, or they may confuse each other, and have as much to unlearn as they have learnt. Whatever tunes they may have acquired must be piped to them occasionally, or they may begin, by dropping a note or two, to forget them, or introduce variations of their own not in the very best taste. But the natural song is better than any they can be taught; it is rich and mellow, wild and hilarious; it thrills the heart, for it is a voice of joy. To teach a blackbird is on a par with painting the lily and gilding refined gold.

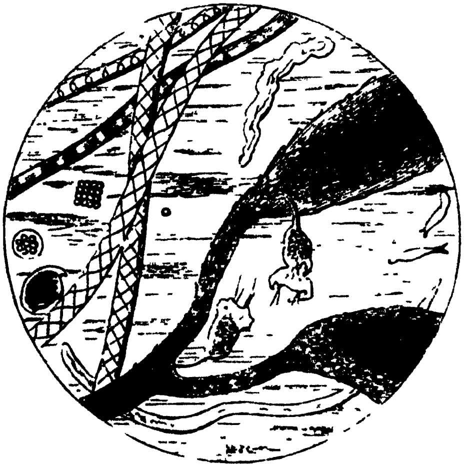
Among the curious experiences of bird-keeping I remember several things worth recording of the blackbird, but it is impossible to afford space for them now. This and the woodlark are both subject to damage in the legs, owing to their convulsive plunging when alarmed, in the process of feeding or cleaning the cages. I had sent to me not long since a hen blackbird which had been used as a decoy by a villanous bird-catcher, who had put it out daily beside his traps, tied by the leg with a piece of string. The poor bird's efforts to regain its liberty had caused a separation of the tendon from the metatarsal or shank bones, and the bird was so lame that it could only use one leg, and when once off its perch was unable to regain it, and had to be lifted on by the hand. It was painfully tame, and submitted with confident patience to a bandaging of the leg with goldbeater's skin, and lived over a year in comparative happiness, in the enjoyment of all the care and coaxing that could be lavished on it as a crippled pet. Mr. Keillick, naturalist, of Buttesland Street, Hoxton, the most able preserver and mounter of large animals perhaps in Europe, prides himself on his skill in administering surgical relief to disabled birds, and among the subjects operated on was a blackbird of extraordinary fine song, which had both its legs broken through plunging in fright when attacked by a cat. By means of thin splints of whalebone the bird was propped up, recovered partially the use of its legs, but was never able to perch again. It lived several years hopping about like a wooden-legged pensioner at the bottom of its cage, and sang gaily to the last.

Albinism is a common occurrence among blackbirds, and of course most striking and remarkable, because a white blackbird is of necessity a paradox. Bechstein says "the white variety is *well known;* there are besides the streaked, the black with a white head, and the pearl gray." Neville Wood says, "I have seen a female pied with black and white, which was with egg when it was shot." I have seen two pure white specimens: one of these was exhibited in company with a six-legged pony in a yard in Blackfriars Road, about twenty-five years ago, and was declared by its learned proprietor to be "a white blackbird, the eighth wonder of the world, and the astonishment of all the doctors as 'ad ever seen it." The other I saw about three years since when visiting the beautiful ornithological museum of Dr. Hobson at Leeds. He has also a white sparrow, and several other bird albinos.

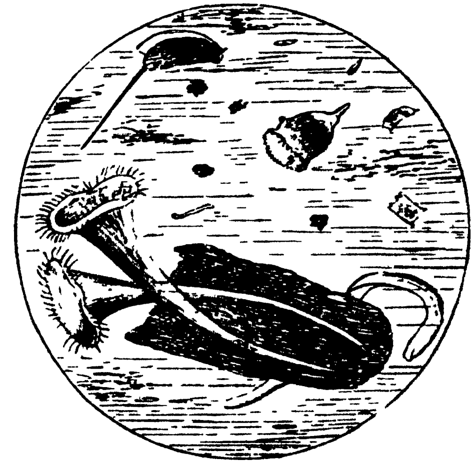
SHIRLEY HIBBERD.

THE AQUARIUM IN MINIATURE.

When I was a child I was presented by my father with a small microscope, in those days a rather uncommon plaything, and one which, although greatly prized by me, I was yet not fully able to manage so as to become acquainted with all its power. I became also possessed of some books not exactly suited to a childish capacity, but exciting in me the strongest possible desire to see and know more of the wonders therein so glowingly described. I read of "Wheel Animals," and "Globe Animals," and "Bell Animals" as of so many creatures of a fairy tale, but without conceiving that it could be within the reach of an instrument like mine to display such marvellous sights. I therefore contented myself with the large animalcules which tinged our pond either with a red or greenish hue, and which of course were visible enough to the naked eye. After a time the same sights, so often repeated, lost their novelty, and the microscope was laid aside and scarcely remembered for many years. In the course of one winter, however, being rather at a loss for amusement, something brought the microscope to mind, and having searched it out and put it in tolerable order (first taking it to an optician, who scarcely condescended to give it a second look, as being of a description totally obsolete and unworthy in his opinion of any restoration, of which in truth it stood in much need, the mirror being greatly damaged), and otherwise accomplished the little that could be done in such circumstances, I set about making discoveries.



Gonium pectorale.—Water from a pond on a common from which peat is cut for firing. A black turfy soil.



Trumpet Animalcules, drawn from preservations attached to a piece of decayed leaf. Water from a pond with a brook running into it, with water-cresses, etc. A sandy soil.

Being in the depth of the winter, living flowers and *dead* insects (for I have an utter horror of scientific cruelties) were equally scarce, and with the ancient instrument in my possession I hoped for nothing more than a sight of the most common things. It was, therefore, as a sort of "forlorn hope" that I bethought me of a deep and dirty little pool, or rather *pit*, of water, surrounded by hazel bushes and apple-trees, which completely overshadowed it, and which consequently filled it during the autumn with both withering leaves and decayed apples, a mixture not desirable to stir up in any way, but which I fancied (in my ignorance of its *scientific value*) might contain something worthy of inspection. That it would have done so in the spring and summer I knew from the swarms of tadpoles, young frogs, water-fleas, and whirligigs which enlivened its surface

A cluster of *Rotifer vulgaris* attached to some decayed substance, the whole resembling some animal in motion. The Wheel Animalcules from a leaden roof where decayed leaves lay in small pools of rain water. They were larger than in the ponds, and had a rich crimson tint apparently from feeding on the red sediment around them.

in the warm weather. But it was winter, and I really did not expect to find anything awake and active at such a season. However, I sent for a cup of the aforesaid mixture for my evening's amusement.

One hears and reads in these days of the various powers and parts of the noble instruments employed by those who are engaged in these fascinating pursuits, of object-glasses, animalcule cages, condensers, reflecters, etc. My microscope has apparently only one power, and my little aquarium—for I do not know its proper name—is about the size of a sixpence, having a glass bottom surrounded by a ring of brass, but without any cover. Into this little aquarium I poured my dirty water, and there, to my great surprise, I perceived that the wintry weather had not affected the world of life contained in the deep and muddy pool; and there also, still more to my surprise, I found not only things visible to the naked eye, but things with

Brachionus and *Vorticella convallaria.*—Chiefly from water kept in a dish throughout the year in a greenhouse, except the large bells.

which I had been hitherto acquainted but by name. How they escaped me in former years I do not know. Having thus once lifted up the veil of an invisible world, I spent evening after evening in exploring its curiosities, and so captivating did I find the study of these living objects that all others appeared uninteresting in comparison. I ought not, perhaps, to offer any of my unlearned observations to a scientific periodical, for I know but little of these matters scientifically, yet, judging from myself, I am led to suppose that remarks made by one who has had no assistance from any really good instrument may be interesting to those who possess as little advantage themselves, and may afford even more encouragement than they can derive from the truly valuable information of others.

The minuter animalcules and the minuter parts of animalcules are of course but slightly perceptible with such a microscope as mine, yet what I have seen has produced that feeling of awe which cannot fail to be awakened at the remembrance of a Creator, whose infinite wisdom is thus manifested in the most marvellous way, by the formation of beings so entirely out of the reach of man's unassisted vision—beings of the most extraordinary construction, and endued with the most varied powers of action; and what seems yet more difficult of apprehension, each with an instinct and even a will of its own, as if intellect (if we may so term it) could be meted out in atoms no less than matter.

The pleasure to be derived from this little aquarium consists in the sight of so many creatures engaged in their respective pursuits; for the greater part of these tiny beings seem to be very little incommoded by their removal from the pool to the sixpenny-sized glass. It is a pool to them, and they continue their search for prey and their sportive movements without any greater restraint than the circle of brass necessarily causes by confining them to a lake, as it were, instead of an ocean. There is still room for them to wheel around, to dip and dive, and perform their customary evolutions. It is not, therefore, like seeing a larger insect compressed or imprisoned for the greater facility of inspection. Science may demand more than my little aquarium can afford, but very instructive amusement may be derived from it, free also from the unpleasant feeling occasioned by witnessing distress and suffering, unless, indeed, such as is caused by the habits of the creatures themselves.

My first dips into the cup of dirty water astonished me, but I forget what might be exactly their results. I remember chiefly that the muddy sediment resolved itself into mossy-looking fibre and miniature rocks and boulders, the first of which seemed alive with fish-shaped animalcules (*Paramecium chrysalis*), moving about over and under each other in all directions, now slowly and now swiftly, as they mixed with or were separated from the general crowd. The colours imparted to these transparent animalcules by the microscope (gold, and pink, and blue) rendered them extremely pretty, and as they passed under and were seen through each other, crossways or endways, their numbers caused them to resemble a gay and moving carpet of variegated hues.

These animalcules, I may as well observe, are not fish-shaped when more closely inspected; it is only their general appearance which I am here describing. The bottom of the glass was strewed with many odd-shaped things, such as part of a fly's wings, or of a drowned gnat, or the long feathery appendages of some deceased insect; but the most observable at that time was the hollow shell, or rather whole case, legs and all, of the water flea, which lay like a huge wreck in its transparent beauty, a broken hull of crystal; and inside this huge case would be four or five of the mimic fish above named, swimming about and exploring its recesses, searching even into the hollow legs, narrow as they appeared, apparently for food, and thus proving by comparison their own minuteness of size. Then from among the thick crowd around a different creature (*Kolpoda cucullio*) would work its way, with a kind of *wimbling* motion, an oblong or seed-shaped shining thing, with a round globe swelling from the middle of its side bright and transparent; and onward it would move end downwards and twirling unsteadily, somewhat like a boy's top when about to cease its spinning; whereas the *fish* moved more like fish swimming, or darting in a fish-like manner, and seeming to nibble occasionally at the sides of anything which took their fancy, or to turn hastily away from whatever was useless or repulsive.

It seems strange and wonderful that even in these (to human sight) invisible specks of life there should be degrees of intelligence as among the larger insects or animals; but it certainly is so. Each has, of course, the instinct sufficient for its own peculiar well-being, but some appear more evidently sportive than others, and some as exercising more choice or, if it may be so called, judgment in their actions. Some are of a more ferocious and tiger-like character, cruel in their method of killing their prey, and seeming to enjoy the power of tormenting; others content themselves with at once swallowing down the living food, which they draw into their cavern-like throats. The little aquarium was, of course, often emptied and replenished, and the contents of the cup returned to their native pool, so that I had constantly new scenes before me.

After a time I took to making infusions of various substances, as recommended in books on microscopic subjects, and by that means secured objects of investigation when, from wet weather or other causes, the pool was not available. In one point, however, I continually failed; it was in producing anything of the *Amœba* kind, according to a method I had seen described in some periodical, viz., the soaking of a piece of raw meat in water. I have tried this plan more than once without success, and only on one occasion was I so fortunate as to find an *Amœba* in the water, either of a different infusion or of some pond, I forget which.* I did not then know the name of this strange-looking animalcule, and therefore paid less attention to it than I should otherwise have done. I have never since succeeded in finding another. The many evenings I have devoted to these interesting investigations, and the various little scenes I have witnessed going forward, in the space of a sixpence, among creatures for the most part invisible without the help of the microscope, have caused me to think that they may be worth noting down for the amusement of others—I cannot say for the advancement of science, since, as I before observed, my remarks are only those of a learner. The most inexperienced eyes can, however, see in these things the workings of Almighty power, and the most unlearned writer who can describe them will hardly fail to awaken in the minds of thoughtful readers some sense of the unapproachable wisdom of the God who created them, and who provides for every unseen individual among them the means of preserving and of enjoying its existence. Before such marvels the spirit of the observer seems to fall prostrate in the presence of Inconceivable Deity, and is constrained to exclaim with Job of old, "Lo, these are parts of his ways; but how little a portion is heard of Him! But the thunder of his power who can understand?"

M. G. C.

THE ANECDOTE HISTORY OF PHOTOGRAPHY.

COLLECTION IV.

Photography on Wood.—A process has been brought out in America for photographing on wood instead of drawing by hand. The surface of the wood is so prepared as to be sensitive to light, and the image is impressed on the block in the ordinary way. They are rather faint productions, but it is hoped by improved processes to produce them with the vigour and strength of Indian ink work, and by aid of them facilitate the production of illustrated works and newspapers. Since the date of this invention, Herr Paul

* River water kept a *long time* will generally produce them.—Ed.

Pretsch has succeeded in the production of blocks for surface-printing by means of photography alone, aided by chemical reagents, but wholly dispensing with the assistance of the graver. Specimen prints from these blocks were published in the "British Journal of Photography," and the "Photographic Journal" of November, 1860.

SUN ENGRAVING ON MARBLE AND LITHOGRAPHIC STONE.—The ornamentation of marble and stone with designs engraved by the photographic process for architectural decoration, is due to M. Niepce de St. Victor. He lays his heliographic varnish on the marble or stone, and obtains impressions, either sunk or raised, and considers that the process may be made of service to architects and to workmen in the production of clock-stands, pedestals, paper-weights, and mantel-pieces. He uses fine black marble, yellow or blue calcareous stones, Carrara marble for mosaics, and Judean bitumens. Images of natural objects may also be obtained on these materials by placing them properly prepared in the camera.

CALICO PRINTING BY PHOTOGRAPHY.—A process has been discovered by M. Persoz, Professor of Chemistry at the Conservatoire des Arts et Métiers, for applying photography to the purposes of calico-printing, and by means of which the important branch of the art known as positive printing may be conducted without recourse to the precious metals, or any expensive chemical compound.

PHOTOGRAPHY APPLIED TO WATCHES, DIALS, AND CLOCKS.—Photography applied to watches, dials, and clocks, for giving the hours, minutes, and seconds with precision on white or tinted opal glass, and for printing artistic designs on such dials, is due to Messrs. Glover and Bold, of Liverpool. They are also rendered susceptible of receiving colours.

PHOTOGRAPHS OF PATTERNS AND ARTICLES OF SALE.—Photographs for commercial purposes of patterns for exhibiting to purchasers are not uncommon, enabling the commercial traveller and others to dispense with a heavy load of samples when visiting their customers.

PHOTOGRAPHY UNDER WATER.—A photograph has been taken of the bed of the sea in Weymouth Bay, by Mr. Thompson. The camera was placed in a box with a plate-glass front and moveable shutter to be drawn up when the camera was sunk to the bottom. The camera being focussed in this box on land for objects in the foreground, at about ten yards, was let down from a boat, carrying with it the collodion plate, and the shutter raised and the plate exposed for ten minutes. The box was drawn up and the image developed was of rocks and weeds; but the great advantage anticipated to be derived from this application of the art, is to obtain a knowledge of the condition of piers, bridges, piles, and structures under water. A specimen of submarine photography may be seen at Lloyds' Aquarium Depôt, 19 and 20, Portland Road, Regent's Park.

PHOTOGRAPHY AND VEGETABLE PHYSIOLOGY.—M. Ville, in his researches on vegetation, has followed out the growth of corn from several countries, cultivated under certain conditions, so as to establish comparisons between the different grains. He has made a collection of photographs that illustrate these harvestings, and, taken on the same scale, these proofs give at a single glance a view of the results obtained, and show the minutest variations.

PHOTOGRAPHS OF RAILWAY ACCIDENTS.—It is now by no means an uncommon custom, on the occurrence of a railway accident, to take photographs of the scene of the disaster, and of the exact position of train, and carriages, and debris, to enable juries and the government inspector to arrive at a clear comprehension of the catastrophe. On the occasion of a late fearful accident on the North Kent Railway, photographs of the line and signal posts, with the position of the trains that came into collision, were taken by Mr. Beard, and tended most materially to elucidate the cause and effect of the disaster.

ADAPTATION OF THE PHOTOGRAPHIC ART TO STAINED GLASS.—This is another interesting adaption of the art to industrial service. The process adopted by Mr. M'Innes is to execute the photograph as usual on paper, and by transparent gums or varnish transfer them to the glass, thus giving all the effect of etching or drawing upon glass. Mr. Corey's plan is to apply the enlarged photograph to the pane of glass in the window without ornament. Mr. Forrest takes a square of ruby glass, the inside size of any of the windows of a house, and makes a drawing of the scroll-work, or other pattern, to surround the photograph, covers the outer edge of the glass with black varnish, exposes the bare surface of the glass, surrounds it with a bank of wax, and pours on it fluoric acid. The colour of the glass being entirely external is soon eaten away and the white substance of the material laid bare, presenting a perfectly transparent copy of the pattern, the photograph being placed in the centre dyeing. The tissue to be printed is impregnated with a solution of bichromate of potass, and then exposed to light with the pattern superposed in a species of pressure-frame. The parts acted on by light assume a pale-red tint of a very permanent character. This tint is susceptible of becoming a mordant, and of causing the various dyes in which the fabric may be immersed to adhere to it.

PORTRAITS OF PRIZE CATTLE.—The prize animals at the agricultural show at Paris were all photographed by M. Tournachon at the desire of the French Government. Portraits of the best animals, from all countries, were thus obtained, and copies of them sent through the provinces so as to familiarize the agriculturists of France with the shape and form of the best specimens of breeds of cattle.

CURIOUS APPLICATION OF NITRATE OF SILVER FOR BURNS.—Dr. Willbank, of Philadelphia, states that he has used nitrate of silver in solution, such as is used for photographic purposes, as an excellent application for burns and scalds, protecting the inflamed surface, subduing the pain, arresting discharge, changing the character of the inflammation, and causing a speedy cure. Dissolve twenty to forty grains in an ounce of water, and apply with a camel's-hair brush.

WHAT IS A PHOTOGRAM?—The term photograph implies the means of production. The term photogram is the production itself, just as in the synonymous case of the words telegraph and telegram. The term "photo," however, for brevity, is the one in common use among photographic artists. Translated, the term, derived from *photo* light, and *gramma* a message, signifies a message, or writing, or image by light.

PHOTOGRAPHS OF COLOURED PERSONS.—The photographs of coloured people are remarkably effective, from the fact of the absence of those strong shadings of the features that frequently, in some of the best photographs, disfigure and give a harsh expression to the face, while, on the other hand, the lights and whites come out in characteristic relief.

THE BURNING OF THE NATIONAL DAGUERREOTYPE GALLERY, NEW YORK.—This gallery, which was destroyed by fire, contained the likenesses of the most distinguished citizens of America, and most of them being deceased, there was no duplicate of the likenesses left. On looking over the ruins, where all seemed a mass of ashes, coals, melted glass, brass, copper, and silver, the only photograph said to be found perfect was the one of the celebrated John Quincy Adams.

THE HUMAN EYE AND ITS SIMILARITY TO THE PHOTOGRAPHIC CAMERA.—The eye has its lens and its dark chamber. The walls, so to speak, of this dark chamber are constructed so as to absorb light; but when the light is very strong the pupil contracts, in the same way that a stop is put before the lens of the camera to diminish the chances of reflection from the interior surfaces. The image of things is thrown on the retina and interior of the eye, just as the image is by the lens on the plate or paper on the camera, or on the Daguerreotype plate. Indeed it has been concluded by doctors in America, that the last image formed on the retina of the eye of a dying person remains impressed upon it like the image on the photograph, and that of the last object seen by a murdered person was his murderer, the portrait drawn upon the eye would remain a fearful witness in death to detect him and lead to his conviction. Dr. Sandford, of New York, reports that he examined the eye of a murdered man at Auburn by means of the microscope, and found impressed on the retina the rude, worn away figure of a man, supposed to be the assassin!

PHOTOGRAPHS ON WOOD.—The engraver now takes his portrait or landscape on wood, and then cuts it out with every faithful finish. It was at first thought that the chemical agents required to render the wood sensitive would destroy its fibre; but this is not the case.

PHOTO-LITHOGRAPHY, OR PHOTOGRAPHY ON STONE.—To produce pictures on lithographic stones, by the action of light in the camera, has been found to be a very difficult process; but Dr. Halleur, of Berlin, and others, have succeeded in producing portraits on that material very successfully. The process adopted is to treat the stone in the usual way, to give it the grain required for a fine crayon tracing. It is then saturated with a weak neutral solution of oxalate sesquioxide of iron. It is thus made sensitive to light, and in order to develop the picture and fix it, a solution of carbonate of ammonia is poured over it. Mr. Macpherson has also succeeded in obtaining photo-lithographs.

PHOTOGRAPHS OF THE RUINS OF THE TOWER OF BABEL.—The French consul at Mosul recently sent home an account of a discovery so astonishing, as to render the photographic views and vouchers that accompanied it, necessary as confirmations of its truth. The discovery was that of the ruins of the Tower of Babel, and the photographs exhibited the remaining two stories of this once marvellous structure; the bricks cemented with bitumen, and bearing inscriptions upon them, which, when deciphered, are expected to confirm the accounts of Scripture.

C. M. ARCHER.

NOTES ON THE DIAMOND.

THE diamond is a crystalline mineral, which, on account of its extreme hardness and unsurpassed lustre, has always been considered the most valuable of the precious stones. The natural and essential properties of the diamond, which exhibits but a single refraction of the sun's rays, are transparency and brilliancy. It has been proved, by Sir Humphry Davy and others, that notwithstanding it is the hardest of all known solids, it consists solely of carbon, being, in fact, crystallized charcoal. When heated, without the contact of air, it undergoes no change, but if ignited in contact with it, it is totally converted into carbonic acid gas. There are two kinds of diamonds, the oriental and the occidental, or Brazilian, the former of which is the most highly prized; they are either colourless or of a yellowish, bluish, greenish, or rose-red tint, and are transparent or translucent. A black variety has recently been found which is entirely opaque. When quite pure it is as transparent as a drop of the clearest water, in which state it is called a diamond of the first water; and in proportion as it falls short of this perfection, it is said to be of the second, third, or fourth water, till it becomes a coloured one.

The matrix in which diamonds are found imbedded, is generally composed of broken and rotted fragments of quartz, and they are all obtained by the process of *washing*. The stones and rubbish with which they are mixed are first thrown into a cistern containing water, having a cock and a plug at the bottom. The lumps are then broken, and the dirty water drawn off till the stones are washed clean. The sand and stones which remain are then carefully examined in the sunshine, and so clever are the searchers in this business, that the smallest stone cannot escape their notice, and the rays of the sun being reflected by the diamond greatly assists them in the work. The finest are, of course, reserved for ornamental purposes, but great quantities of the coarser kind are reduced to powder for the purpose of cutting and polishing other precious stones. The pencil diamond, used in cutting glass, is a small fractured piece of diamond, the part used being of a trapezoidal shape, weighing about the sixtieth part of a carat,* and is set in a wooden handle. Being the hardest of all known substances, it can be polished only by the friction of portions of the gem itself reduced to powder, and can only be cut or worn down by rubbing one diamond against another, hence the common expression of "diamond cut diamond." Its specific gravity is 3 52. The principal localities in which diamonds are found are in India, Brazil, and Borneo; they are also found in Siberia and Africa.

The different sorts of diamonds are as follows:—*Rough diamond* is the stone as it is taken from the mine; *rose diamond* is that which has a flat base, terminating in a point above; the *table diamond* is that which has a square face at the top, encompassed with four lesser facets; the *brilliant* is that which is cut into flat faces at the top and bottom, and whose table, or principal face, is parallel with a line through the broadest part of the stone. The diamond is always found in detached crystals, whose primary form is the octohedron, but which presents a variety of modifications, leading from the primary octohedron to a rhombic dodecahedron. In some crystals the planes are all curved.

* A carat is equal to 3·166 grains troy.

The finest ever known was the Koh-i-Noor, or mountain of light, exhibited in the Great Exhibition of 1851. It weighed $118\frac{1}{16}$ carats, was of the very purest water, and was valued at £1,500,000; but it was afterwards reduced by cutting into $102\frac{1}{16}\frac{3}{}$ carats. Its present worth is supposed to be about £83,240. It is in the possession of Queen Victoria. The largest diamond ever known belonged to the King of Portugal; it was brought from Brazil, weighed 1680 grains, and although it was not cut or polished, it was valued at £5,644,800. That in the Russian sceptre weighs 193 carats, and cost £104,167. The most perfect and beautiful diamond ever known is a brilliant. It was brought from Malacca by a gentleman named Pitt, was cut in London, and afterwards sold to Louis XIV. for £130,000. It weighed 139 carats.

The full-sized diamond is of more value than a hundred thousand times its mass in gold; it is the most cherished property and the proudest ornament of kings; the most highly prized and the brightest jewel in the chaplet of beauty, and yet it is (using the language of a recent author) but a lump of coal, which heat reduces to a cinder and dissipates into that insalubrious gas which ascends from the most putrid marsh and bubbles from the filthiest quagmire.

Bradford. THOS. ALLEN BLYTH.

AZOTONE is the companion of ozone, and is so named by Prof. Schœnbein. It has not yet been obtained in an isolated state. It is present sometimes in fluor-spar, and is the cause of its occasional peculiar odour.

METEOROLOGY OF MARCH.

FROM OBSERVATIONS AT HIGHFIELD HOUSE OBSERVATORY.

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Year.	Mean Temperature of the Air. Degrees.	Mean Temperature of the Dew Point. Degrees.	Mean Pressure of the Air. Inches.	Mean Amount of Cloud. (1—10).	Number of Rainy Days.
1846	43·5	—	—	6·7	20
1847	43·7	38·5	29·768	4·5	15
1848	43·0	38·3	29·583	7·9	24
1849	41·4	37·1	29·933	7 0	12
1850	40·0	35·2	30·020	5·2	5
1851	41·6	37·3	29·587	7·3	18
1852	40·8	35·4	30·056	6 2	6
1853	37·9	35·3	29·808	6 8	16
1854	43·7	37·2	30·155	5 9	5
1855	37·0	31 9	29·529	7 5	16
1856	39·2	33·4	30·147	8 0	7
1857	41·4	35·9	29·681	8 7	20
1858	42·2	36·8	29 724	5·4	10
1859	45·3	39·6	29·720	7·3	16
1860	40·5	37·1	29·583	7·8	23
Mean	41·4	36·4	29·818	6·8	14

The mean temperature of the last fifteen years, for March, is 41·4°, the range in the mean temperature being from 37 0° in 1855 to 45·3° in 1859—a difference of 8·3°. The lowest means occurred in 1853, 1855, and 1856; and the highest in 1846, 1847, 1848, 1854, and 1859.

The mean temperature of the last fifty years, for March, is 42·1°, the lowest mean occurring in 1845, viz., 35·6°, and the highest in 1822 and 1830, viz., 46·6°—a range of 11 0°.

The mean temperature of the dew-point of the last fourteen years, for March, is 36·4°, the range being from 31·9° in 1855 to 39·6° in 1859—a difference of 7·7°, the lowest means occurring in 1855 and 1856; and the highest in 1847, 1848, and 1859. The temperature of the dew-point was in 1854 as much as 6 5° below that of the temperature of the air, and in 1853 as little as 2·6°; the mean difference being 5·0°.

The mean pressure of the last fourteen years, for March, is 29·818 inches at the height of 174 feet above the mean sea-level, ranging between 29·529 inches in 1855, and 30·155 inches in 1854—a difference of 0·626 of an inch (or above six-tenths of an inch). To reduce these readings to the sea-level, it is necessary to add 0·191 of an inch, when the mean temperature is as low as 37·0°, as in 1855; and 0·188 of an inch when it is as high as 45·3°, as in 1859. On applying this correction, the mean pressure, reduced to the sea-level for March of the past fourteen years, is 30·007 inches.

The mean amount of cloud, for March, is 6·8 for the past fifteen years; the amount ranging between 4·5 as in 1847, and 8·7 as in 1857—a difference of 4·2, or four-tenths of the whole sky. The years of least cloud were 1847, 1850, and 1858, and of most cloud, 1848, 1856, 1857, and 1860.

The mean number of rainy days, for March, of the past fifteen years is 14, ranging between 5 in 1850 and 1854, and 24 in 1848—a difference of 19 days. The years of but little rain are 1850, 1852, 1854, 1856, and 1858; and of many rainy days, 1846, 1848, 1857, and 1860.

E. J. LOWE.

ASTRONOMICAL OBSERVATIONS FOR MARCH, 1861.

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THE Sun is in the constellation Pisces until the 20th, when he passes into Aries. He is situated south of the equator, and then north. He rises in London on the 1st at 6h. 48m., on the 10th at 6h. 28m., on the 20th at 6h. 5m., and on the 30th at 5h. 42m.; setting on the 1st at 5h. 38m., on the 10th at 5h. 54m., on the 20th at 6h. 11m., and on the 30th at 6h. 28m.

The time the Sun is above the horizon in London is on the 1st 10h. 50m., on the 10th 11h. 26m., on the 20th 12h. 6m., and on the 31st 12h. 49m.

The Sun rises at Edinburgh on the 5th at 6h. 44m., on the 22nd at 6h. 17m., and on the 31st at 5h. 33m.; setting at Edinburgh on the 6th at 5h. 44m., and on the 22nd at 6h. 17m.

The Sun rises in Dublin on the 3rd at 6h 47m., on the 10th at 6h. 30m., and on the 29th at 5h. 42m.; setting in Dublin on the 4th at 5h. 41m., on the 11th at 5h. 55m., and on the 30th at 6h. 28m.

Day breaks in London on the 3rd at 4h. 52m., on the 8th at 4h. 37m., on the 15th at 4h. 24m., on the 24th at 4h. 0m., and on the 28th at 3h. 46m.

Twilight ends in London on the 4th at 7h. 36m., on the 9th at 7h. 46m., on the 16th at 7h. 58m., and on the 29th at 8h. 26m.

Mercury is in Pisces at the beginning, and in Aquarius at the end of the month; an evening star till the 16th, and then a morning star. He is well situated for observation at the commencement of the month, setting due west nearly two hours after the sun. He rises on the 1st at 7h. 7m. a.m., on the 11th at 6h. 18m. a.m., and on the 21st at 5h. 27m. a.m.; setting on the 1st at 7h. 25m. p m., on the 11th at 6h. 52m. p.m., and on the 21st at 5h. 23m. p.m.

Venus is in Capricornus at the beginning, and in Pisces at the close of the month. She is at a great distance from the earth, and inconspicuous, her apparent diameter not exceeding 12″. She is a morning star, rising on the 1st at 6h. 20m. a.m., on the 11th at 6h. 7m., and on the 21st at 5h. 50m. a.m.; setting on the 1st at 3h. 51m. p.m., on the 11th at 4h. 22m. p.m., and on the 21st at 4h. 54m. p.m.

Mars is in Aries at the beginning, and in Taurus at the close of the month; an evening star, and somewhat conspicuous. He rises on the 1st at 8h. 24m. a.m., on the 11th at 7h. 58m. a.m., and on the 21st at 7h. 33m. a.m. Throughout the month she sets either at 11h. 7m. p.m., or 11h. 6m. p.m.

Jupiter is in Leo, and a most conspicuous object, his apparent diameter about 40″, being the brightest star in the heavens, and visible throughout the night, rising on the 1st at 3h. 23m. p.m., on the 11th at 2h. 37m. p.m., and on the 21st at 1h. 54m. p.m.; setting on the 1st at 6h. 23m. a.m., on the 11th at 5h. 42m. a.m., and on the 21st at 5h. 0m. a.m.

Saturn is in Leo, and visible throughout the night, a fine telescopic object, rising on the 1st at 4h. 54m. p.m., on the 11th at 4h. 10m. p.m., and on the 21st at 3h. 27m. p.m.; setting on the 1st at 6h. 58m. a.m., on the 11th at 6h. 18m. a.m., and on the 21st at 5h. 37m. a.m.

Uranus is in Taurus, and visible throughout the evening, rising at 9h. 44m. a.m. on the 1st, on the 11th at 9h. 5m. a.m., and the 21st at 8h. 27m. a.m.; setting on the 1st at 1h. 56m. a.m., on the 11th at 1h. 17m. a.m., and on the 21st at 12h. 30m. a.m.

Occultations of Stars by the Moon:—On the 24th, ρ Leonis (5th magnitude) disappears at 12h. 33m. a.m., and reappears at 1h. 36m. a.m.

Eclipses of Jupiter's Satellites:—On the 4th, at 7h. 22m. 8s. p.m., 3rd moon reappears. On the 5th, at 10h. 34m. 14s. p.m., 1st moon reappears. On the 11th, at 11h. 20m. 34s. p.m., 3rd moon reappears. On the 13th, at 12h. 28m. 36s. a.m., 1st moon reappears. On the 14th, at 6h. 57m. 12s. p.m., 1st moon reappears. On the 16th, at 7h. 59m. 15s. p.m., 2nd moon reappears. On the 19th, at 3h. 19m. 9s. a.m., 3rd moon reappears. On the 20th, at 2h. 23m. 6s. a.m., 1st moon reappears. On the 21st, at 8h. 51m. 43s. p.m., 1st moon reappears. On the 23rd, at 10h. 36m. 2s. p.m., 2nd moon reappears. On the 28th, at 10h. 46m. 22s. p.m., 1st moon reappears. On the 29th, at 2h. 10m. 59s. a.m., 4th moon disappears. On the 31st, at 1h. 12m. 46s. a.m., 2nd moon reappears.

The variable star Algol will reach its minimum amount of light in the evening on the 13th, at 12h. 27m., and on the 16th, at 9h. 16m.

Stars on the Meridian:—On the 2nd, Regulus souths at 11h. 18m. 8s. p.m. On the 2nd, Spica Virginis souths at 2h. 38m. 25s. a.m. On the 4th, Rigel souths at 6h. 17m. 56s. p.m. On the 6th, Sirius souths at 7h. 41m. 0s. p.m. On the 8th, ε Hydra souths at 9h. 39m. 12s. p.m. On the 9th, Castor souths at 8h. 15m. 47s. p.m. On the 11th, Procyon souths at 8h. 14m. 12s. p.m. On the 13th, Pollux souths at 8h. 11m. 7s. p.m. On the 15th, α Hydra souths at 9h. 46m. 55s. p.m. On the 16th, Regulus souths at 10h. 23m. 5s. p.m. On the 17th, Spica Virginis souths at 1h. 30m. 8s. a.m. On the 19th, β Leonis souths at 11h. 52m. 1s. p.m. On 22nd, Regulus souths at 9h. 59m. 30s. p.m. On the 27th, Regulus souths at 9h. 39m. 50s. p.m. On the 27th, Spica Virginis souths at 1h. 0m 8s. a.m.

E. J. Lowe.

THE MICROSCOPIC OBSERVER.

MARCH.

Out-door Practice.—We hear with much pleasure of the continued prosperity of the Liverpool Naturalists' Field Club, the members of which have been working out of doors at intervals all through the winter, chiefly on mosses. Beginners in microscopy will find this subject one of the most entertaining to which they can direct their attention, as the simple task of determining genera and species will accustom the eye to the analysis of structural peculiarities, and train the mind to correct scientific comparisons. For all this class of work the Coddington Lens is a most valuable and necessary adjunct; no field naturalist should be without one, and as a rule no subject should be submitted to a compound microscope until its character has been investigated as far as possible by means of a Coddington, or some other simple lens. The expert microscopist will know that these remarks are not intended for him; experience has taught him what to look for, and how to observe. The beginner cannot do better than proceed from low to higher powers, and no subject should be highly magnified until somewhat has been learnt respecting it by the simplest optical appliances. Among the subjects just now in the best possible condition for examination we enumerate the following as they occur to us.—*Barbula* (*Tortula*) *muralis*, the common well-screw moss, which forms a velvet pile of the most delicious green on old walls everywhere. The fruits will be found now in all their several stages, some having cast off the calyptra, others just parting with it, so that many of the points described in former notes in this series may be studied with the greatest facility as to obtaining subjects. If a tuft of this moss is placed in a shallow vessel of water it will exhibit the escape of the spores by the disentanglement of the fringes.—*Jungermannia bicuspidata*, *J. albicans*, *J. barbata*, *J. setacea*, very pretty, leafy-stemmed liverworts, or scale mosses, common on wet bogs, rocks, and damp banks shaded by trees.—*Jungermannia bidentata* may be found in patches at the roots of trees. If gathered before the spores are set free, and brought into a warm room, the sporanges burst under the eye the moment a drop of water is applied to them, and the four valves form a cross at the summit of each of the stems; the spores are disseminated in the form of brown dust. This dust is a beautiful object under a power of 30 diameters, by which it is seen to consist of minute globular cellules, which again burst, and display each a small filament, which moves rapidly in water, like the spring of a watch, their close association giving them the appearance of a confusion of writhing serpents. The ultimate spermatozoids require a power of 200 diameters for their final examination.—*Polytrichium undulatum*, the common undulated hair-moss, is well known as an inhabitant of shady woods and thickets. This moss is very distinct in form and character, the stem is closely beset with leaves half its full length, and is then bare to the summit, where it terminates in a shaggy cap, or archegone containing the spores. This moss is worthy of notice for a peculiarity of its vegetable multiplication. It sends out horizontal branches, which root and throw up leaf-stems, and thus, independently of its spores, it rapidly increases to large patches, where it finds a suitable *nidus*. This mode of increase is exhibited still more strikingly in *Hedwigia*, which produce a sort of bulbs, or bulbils, or tuberous thickenings, from which roots and branches extend, and the patches of the plant are rapidly enlarged.—*Sphærocarpus terrestris:* this very curious and interesting liverwort is only to be found at this season, and will well repay the microscopist for a walk in search of it. It belongs to the *Riccieæ* section of *Hepaticæ*, and is usually met with in clover and turnip fields. The fronds are palish green, membranous, the lower surface adhering to the ground by radical hairs. The upper surface bears a fructification of the true liverwort type, but inclosed in pyriform sacs (*perichætes*). The spores in the *Archegonium* are without elaters. When ripe the globular sporange is visible through the walls of the perichete.

INSECT LIFE.—*Trichocera hyemalis*, the winter midge, is now plentiful in warm, sunny corners of gardens. These are soon succeeded by the true gnats (*culex*), and observations on these interesting creatures may be resumed. Other insects obtainable now are—*Cicindella campestris*, *Pœcilus dimidiatus*, *P. cupreus*, *Gyrinus natator* and *G. æneus*, *Necrophorus Vespillo*, the Sexton Beetle, *Opilus mollis*, *Chrysomela litura*, *Corixa Geoffroyi*, *Proscarabeus vulgaris*, March Moth, Orange Underwing, Light Orange Underwing.

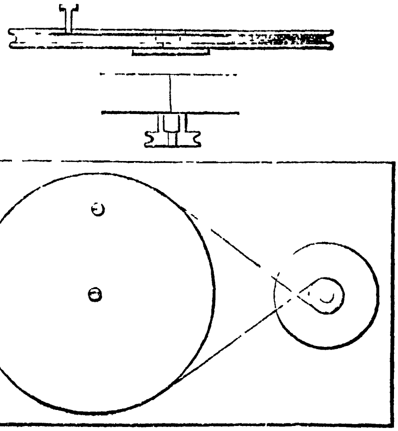
Mr. Noteworthy's Corner.

AMMONIA AND FUNGOID GROWTHS.—Being formerly engaged in making sulphate of ammonia from gas liquor, I noticed that some common flour paste, kept in the warehouse where the atmosphere was impregnated with free ammonia, became covered with a *deep red* mould, or fungus. I think the ammonia must have caused it in some measure, as I have not seen paste with mould on it of that colour in any other situation but where there was free ammonia. One might conjecture from this circumstance that the composition of the atmosphere in some way decided what particular species of plants should flourish in any particular situation.—W. E. R.

COMBUSTION OF ALUMINIUM.—M. Wöhler, the discoverer of this metal, gives the following methods for its combustion:—Conjointly with the leaves of rolled aluminium place a splinter of wood charcoal, so arranged as to touch at once the metal and the wall of the glass vessel; introduce oxygen gas, and heat the vessel by means of a spirit-lamp. Or, roll the leaves of aluminium round a small cylinder of charcoal fixed to the extremity of an iron wire; then light the cylinder and plunge the whole in a jar of oxygen gas. Aluminium leaves inflame spontaneously in chlorine gas.

DATES ON NEW COINS.—A correspondent inquires how the date is affixed to new gold coins, seeing (as stated in these pages) that there has never been but one puncheon for sovereigns since the accession of Queen Victoria. The reply is simple enough. On the puncheon referred to, two figures only of the date appear, and those are 1 and 8; consequently, the engraver has to stamp into the soft steel surface of each coining-die produced from the puncheon, the two remaining figures required to show the exact date—whatever that may happen to be—when the dies are to be used. Thus the date can be altered from year to year, and yet all sovereigns be the product of the same original puncheon, the dies being struck in soft metal, which is hardened after the date has been made complete.

VERTICAL COLOUR TOP.—I have constructed a mechanical colour-top, the simplicity and slight expense of which may, perhaps, attract the attention of some of Mr. Noteworthy's young friends. Mine cost me but a few pence, and consists of a wheel made of well seasoned wood, twelve inches diameter or upwards, and half an inch thick, with groove in circumference one-eighth of an inch deep, and three-sixteenths of an inch wide. At the centre on one side is a projection about two inches diameter, and one-sixteenth or one-eighth of an inch, which diminishes the friction when at work. (To be kept on the lower side.) The hole in the centre, which must be bored



"true," is just large enough for a short piece of three-eighth inch copper gas tube, with a thread on, to be screwed in and filed level on both sides of the wood. Another small wheel is required, with similar groove, about one inch in diameter, and with a piece of copper tube in centre like the other, only smaller. This "bushing" helps to avoid friction. These pulleys are to be fixed to a piece of board, planed smooth, with two common screws of suitable length and strength to fix them firmly, yet allowing them play enough to turn freely round; a small piece of tin-plate, well-flattened, is to be placed under each. A screw with a small piece of tube on it will, when fixed on a larger wheel, form a handle to turn it round by. The wheels are then to be connected by a cord, as in the sketch, and a drop of oil being placed in the centre of each pulley, they will be found to work without noise easily, giving a greater speed, according to size (mine gives about 1000 revolutions per minute), and appears to me to fulfil the requirements of Mr. Noteworthy, as it can be shown vertical, and seen by many. The cords can be fastened on according to individual taste.—W. E. RICHARDSON.

MEMORANDA.—During the late severe weather squirrels were exposed for sale in considerable quantities by the poulterers of Paris along with other curious game not usually included in the winter cuisine.——M. Sudre has confirmed, by experiment, the statement of M. Boutigny d'Evreux that a globule of water in the spheroidal state has a temperature not higher than 206° Fahrenheit, so that boiling water does not consist wholly of fluid particles at 212° ——Glycerine has been successfully applied by M Saute in the formation of floating mariners' compasses in place of water and alcohol ——The new silkworm moth, *Saturnia cynthia*, which feeds on the leaves of the *Ailanthus glandulosus*, the produce of which promises to become an important article of commerce, was figured and described in the *Illustrated London News* of January 12 ——Messrs. Negretti have communicated to the *Times* some remarks on sources of error in records of minimum temperatures, in which they advise the placing of minimum thermometers in such a position that the bulb will be at least one inch lower than the upper end of the instrument, so that if the spirit is volatilized to the extremity of the tube, it may drain back to the bulb when condensed. ——At a recent meeting of the French Academy of Sciences, M. Carré described his apparatus for producing intense cold. Two retorts (one four times larger than the other) are soldered together at their extremities. The larger one (charged to about three-fourths of its capacity with a strong solution of ammonia) is exposed to the action of heat, while the smaller one is immersed in cold water. At about 284° Fahrenheit, the gas ammonia is separated from the solution, and concentrated in the smaller retort. By suddenly plunging the larger retort into cold water the ammonia is reabsorbed, and the water in which the smaller retort is placed is frozen in consequence of the departure of the gas—indeed, a cold sufficient to freeze mercury may be produced (*i.e.*, 40° below zero) This method is intermittent. M. Carre has also devised a continuous process also (described in the *Comptes Rendus*), whereby a still intenser cold may be produced (60° below zero). By these means ice may be readily procured, and M. Carré states that the apparatus may be advantageously applied to the production of fresh water from salt water.

INDEX.

END OF THE SECOND VOLUME.

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