

Lead.

527.—[777]. "Sisha," "surb," from Lahore bazar. RAM SINGH.

Sulphuret of Lead.

528.—[803]. Surma kandahári. Lahore bazar.

Called antimony, but is really a sulphuret of lead, or galena (see page 10). It is brought from Kandahar.

Oxide of Lead—Massicot.

529.—[706]. Murdá sang. Jagádri, Ambálla. LOCAL COMMITTEE.

(754) and (778) are specimens from Lahore.

The manufacture was introduced at Jagádri by Kashmiri and Bakál, two attah sellers, &c., who came from Jalálábád; they manufactured it in secret, and would not let others know the process. They then charged fancy prices for the produce of this monopoly; since then, however, another native of the city, Ali Ahmad, has obtained the secret from a relative of Kashmiri's, and at present about four people, two besides Kashmiri and Ali Ahmad, understand the process.

The apparatus consists of two small mud furnaces, and two earthen vessels the lower parts of which are luted with clay to strengthen them and protect them when placed over the fire; these vessels are small mouthed, and spherical at the bottom, and are called "tolas." They place a quantity of metallic lead in one of them, and heat it over one of the furnaces till it is melted. Supposing the quantity of lead in the earthen jar to be one maund weight, the manufacturer takes in proportion to this quantity, one-quarter of a seer of fine saltpetre; he sits near the furnace and continually stirs the melted lead with an iron spoon, when the lead becomes red hot, he begins to throw in a little saltpetre, and so continues throwing in little by little till the one-quarter of a seer is finished. At this stage the mass becomes a porous pumice-like mass, and it is then taken off the fire, when cold it is transferred to the second earthen vessel, which is ready to receive it, and this is placed on the second furnace. This second furnace is constructed like a hollow dome closed above and open only at both sides, from one side it is lighted and the other side is closed by a valve, consisting of a flat piece of clay with a small hole in it to allow the egress of smoke. The earthen jar with its contents is now placed inside the beehive-like furnace,

supported on two bars of iron fixed within. The workman is furnished with a long iron rod which he inserts into the furnace by one of the lateral orifices, and so reaches the vessel and the lead within, which latter he constantly keeps stirring up: during the process the metallic lead and impurities separate, and when the jar is taken out, murdá sang is found on the surface, and a residue of metallic lead beneath it. The lead that remains, may be again melted, and mixed with saltpetre as before, till all the metallic lead is completely oxidized. About one-half the quantity of lead is converted into massicot at one process.

The cost of manufacture is Rs. 14 per maund, and the selling price Rs. 15 per maund; the manufacturers do not work continuously, but only when there is a demand. About 100 maunds are made in a year, but the quantity varies.

Red Oxide of Lead.

530.—[779]. Sandhúr, red lead. Lahore bazar. RAM SINGH, Pansári.

A similar sample is exhibited from Amritsar. It is usually made at Lahore by exposing melting lead to a stream of air: the process requires careful regulation.

Carbonate of Lead.

531.—[779]. White lead, ceruse, "safáida." Lahore bazar.

532.—[914]. "Kushta sísa." Gúgaira.

Used in making other preparations of lead for medicinal use: it is imported.

Tin.

533.—[799]. Metallic tin. Lahore bazar.

Mercury.

534.—[764]. Símb, (lit. "silver water") or párá. Amritsar bazar. LOCAL COMMITTEE.

535.—[772]. Pára, from Lahore.

Sold in small hollow pottery ware balls, with a minute hole stopped with wax.

Calomel.

536.—[749]. Raskapúr. Amritsar. LOCAL COMMITTEE.

537.—[776]. Raskapúr. Lahore.

A ponderous crystalline mass. Contains calomel

mixed with corrosive sublimate. It is made at Lahore and Amritsar by subliming sulphate of mercury with common salt : it is used in medicine as a powerful alterative.

Bichloride of Mercury.

538.—[748]. Dar chigná, corrosive sublimate. Amritsar.

539.—[775]. Dar chigná. Lahore.

This is also a powerful alterative and corrosive poison. It is made at Lahore.

Sulphide of Mercury.

540.—[752 and 1395]. Shingarf, cinnabar. Amritsar.

Sold in red specular crystalline masses, which are native cinnabar. The brightest native cinnabar comes from the Philippine islands.

541.—[774]. A sample from Lahore.

It is used in medicine ; sometimes as a fumigatory. It occurs native as an ore, or is made by combining mercury with saltpetre, and subliming the product.

Silver.

542.—[770]. "Wark chandi," silver leaf. Lahore. RAM SINGH.

Used in native medicine.

543.—[771]. "Chandi kimal," dross produced in silver melting. RAM SINGH.

Nitrate of Silver,

544.—[842]. Sang-i-jehannim, or "kástak" (corruption of "caustic") lunar caustic.

Made at Lahore by dissolving metallic silver in nitric acid.

Gold.

545.—[768]. "Sona ka wark," gold leaf, Lahore bazar.

546.—[769]. Dross of gold melting pot, "sona ka mail."

A dark colored slag in small fragments, consisting of lead, iron and tin, partly oxidised. Gold leaf is now discarded from European medicine : it is used as a test.

Lignite.

547.—[703]. Sang-i-salájit. Taharpúr, Ambálla. LOCAL COMMITTEE.

[701]. Salájit, from Tosham, Hissar.

548.—[868]. Salájit, from Lahore.

This substance has no place in European practice.

Momyai.

549.—[841]. Momyai. Lahore.

This is in reality a dry mass of tar. Real momyai is said to be rarely met with ; it is supposed to be of great efficacy in healing bones, it is in fact a "osteocolla." It is said to come from Persia, where it exudes and floats on the surface of a certain spring, whence it is collected and monopolized by the government, who sell it at a high price. A story is told, that it was discovered by a certain prince, who when out hunting wounded an antelope and broke its leg ; the animal limped away towards a spring near, and was presently observed to be much restored : the attendants went to the spring, and discovered the momyai, which was afterwards tried, and determined to be invaluable for healing broken bones ! Pieces of coal or salájit are sometimes sold as momyai.

550.—[2943]. Zifti rúmi is also tar.

551.—[604]. Momyai. Ladákh. H. H. THE MAHARAJA OF KASHMIR.

Appears to be a hardened petroleum.

552.—[870]. Kahruba, amber. Lahore bazar.

It is brought from Bombay. In reality is a fossil gum resin, but natives have a superstition, that it exudes by the influence of the sun on particular days from the stem of the plantain, which on ordinary days they state gives out the sundras (gum resin of *Vateria Indica*), and which they class along with amber. Amber is represented in medicine by succinic acid, succinate of ammonia, &c.

Compound Mineral Drugs.

553.—[712]. Five (so called) metallic salts, or kushtas, from Simla States.

(1.) Kushta mánga. A pink powder, which is intended to be powdered coral, which is used by natives as a drug ; but the sample is *not* pounded coral.

(2.) Kushta abrak. Black tale pounded fine.

(3.) Kushta hartál. A gray powder, contains no trace of arsenic ; contains carbonate of lime.

(4.) Kushta mis, or támbá. Is a black oxide of

copper, prepared by mixing some salt of copper with saji ; or impure carbonate of soda.

(5.) Kushta kalai, a preparation of tin or zinc.

554.—[914.17]. Series of compound mineral medicines called kushtás, consisting of—kushta sikka, kushta jast, kushta támba or mis, and kushta loha. From Syadwalla, in Gugaira.

These are preparations made as medicines by natives hakims, they are not unfrequently compound bodies (murakkab), though called by the name of a simple constituent, taking their name from the metal which forms their basis.

The following is an account of these preparations sent from Gugaira, which was kindly communicated to me by MR. R. G. MELVILLE, Offg. Deputy Commissioner.

Kushta sikka, or carbonate of lead.—1 tolah of lead is placed in an iron pan, with the juice of the *Euphorbia*, or the "kesu," or "dhak" flower (*Butea frondosa*). The lead is covered up with the flowers in the iron pan, which is then placed over a fire, where it remains till the lead is melted and the flowers are incinerated. After it is cool it forms the oxide, which is then ground fine and kept for medicinal purposes; it is efficacious in menorrhagia, &c. Given in doses of one "ratti" (the weight of one seed of *Abrus precatorious*).

Kushta jast, or oxide of zinc.—2 tolahs of zinc are placed in a small iron crucible having a handle (called karchi), this is placed in a furnace which is urged with bellows, as soon as it is melted it is to be constantly stirred with an iron rod, when it oxides by contact with the air. It is used as a medicine for diseases of the eye (ophthalmia).

Kushta támba, or arsenite of copper.—1 tolah of copper is taken and beaten out into a thin sheet, after which it is cut up into small slips, to which 1 tolah of "hartál" or orpiment is added, both are tied up together in a piece of cloth and the little parcel is covered with 4 seers of cow dung, it is then set fire to; when burnt, there remains a bluish crisp substance, which is then ground in a mortar and kept for use. It is used as a medicine for paralysis, contraction of the limbs, and arthritis.

Kushta loha, called kluhs ul hadid, or zafrán ul hadid.—1 tolah of iron is made red hot and cooled in cows' urine 100 times, and washed with spring water fifty times, it is then broken and ground in a mortar, after which it is mixed with the milk of "mudar," or "akh" (*Calotropis procera*), and made into a cake; it is then placed in a small crucible called "kothá-

li," and put between 4 seers of dried cow dung and set fire to; it is then taken out and mixed with the juice of a plant, "ghikwar" or "koár gandal" (*aloe perfoliata*) five times, and afterwards mixed five times with the extract of a shrub called "kandyári" (*solanum Jacquini*), burning it between each time of mixing; after which it is again mixed five times in the same way with a grass called "háthi súndibáti," it is then soaked in "dhai" (curdled milk), and the infusion of "bahera" (fruit of *Terminalia belerica*), har (*T. chebula*) and aonlá (*Emblica officinalis*), it is then soaked again in "koar gandal" juice three times, and eventually ground in vinegar. When dry it is then used as a medicine in liver complaints; also for hemorrhoids and stricture of the urethra (*silsil-ul-baul*). In doses of from two to four rattis.

Mineral Waters and Deposits therefrom.

The mineral springs of the Punjab are always situated either in the hills or in submontane districts; there are hot springs, saline and sulphurous waters. Petrifying streams, in limestone districts, are not uncommon.

The following series of mineral waters was exhibited by the LOCAL COMMITTEE OF KANGRA DISTRICT.

555.—[270]. Water, from Bishasht, Kangra. Kálú.

556.—[271]. Water, from Manikarn.

The temperature of Bishasht spring is 102° Fahr. That of the principal spring at Manikarn 202° Fahr. MR. MARCADIÉU states that neither of these springs contains sufficient mineral matter to warrant its being termed a mineral spring; and that if there be any foundation for the high estimation in which these waters are held by the people, it must be merely in the salutary effects of hot baths.

This conclusion, however, has not been generally received, and a fresh analysis of the water seems desirable.

557.—[272]. Water, from the Jawá-líji spring.

The Jawáli Mukhí range is a portion of the outer parallel of the Sub-Himálayas. It is composed of a sandstone of the later tertiary period. The springs are situated all within a distance of about 30 miles, near the base of the hills, on their south westerly face, looking towards the Beas; all contain chloride of sodium (common salt) and iodine, stated by Mr.

MARCADIEU, to be in the form of iodide of potassium in considerable quantity.

In proceeding by order of their respective positions, and taking for starting point the limits of the Jawálá Mukhí valley, naturally formed by an elbow of the Beas near Nadaun, the salt ioduretted springs are placed in the following order; 1st, Kooperah; 2nd, Jawálá; (two springs); 3rd, Jowálá Mukhí; 4th Nageah, and 5th, Kanga Bassá.

The three first are situated at equal distances of about four miles one from the other, the fourth at about three miles from the third, and the fifth at about twenty miles from the fourth.

In general, the greatest uniformity exists in this range of hills.

The argillaceous marls alternate towards the superior part, with a rough and friable micaceous sandstone; and at the inferior part, with a sandstone also micaceous, harder, smaller grained, and of a bluish color, held together by a calcareous cement.

After this comes the same sandstone, in which are embedded a few stones of variegated grit and micaceous sandstone, and next to it a scanty calcareous formation in the state of travertin; at last, on nearing Kangra, and leaving the springs, there are some conglomerates, composed of granite, of mica schists, of quartz, and of variegated sandstone, also bound together by a calcareous cement, alternating at first with the grit, and afterwards forming whole beds by themselves.

The natives of the place affirmed that the saline matter in the springs became more abundant during the rains, and that it yielded them a large quantity of salt.

The saline springs contain, in 100 parts, the following quantities of fixed matter:—

Kooperah,	2.20
Jawálá,	2.63
2nd spring, Jawálá,	2.40
Jawálá Mukhí,	2.28
Nageah,	2.22
Kanga Bassá,	2.32

The temperature of the first spring taken on the 10th December, 1854, at 7 o'clock A. M., was 67° Fahr., the air 51.30, difference 15.70.

This spring issues from a hole made by the natives in the hard grit, it does not appear very abundant, because its issue is evidently impeded by the surrounding rocks which prevents one from ascertaining the real volume of its water in a given time.

All the water from the five springs after having undergone slight concentration by being exposed only for a few hours to the open air, is purchased by the

bunniahs at one anna per seer, or exchanged for the same value in attah, &c.

The livelihood of the natives living in the vicinity of these springs is chiefly earned by this trade.

They are convinced, and tell all who question them, that the water contains an efficacious principle which promotes the cure of the goitre.

The following Table shows the produce yielded by the saline ioduretted springs.

Name of spring.	Parts of water.	Salt.	Iodine.	Equivalent in ioduret of potassium.
Kooperah, .. {	1.000 45.454	22 1.000	0.0799 3.6318	0.1052 4.7818
Jawálá, .. {	1.000 38.000	26.30 1.000	0.09324 3.5452	0.12273 4.6665
Jawálá, 2nd spring, ... {	1.000 41.666	24 1.000	0.0799 3.4958	0.1052 4.8833
Jawálá Mukhí, .. {	1.000 43.860	22.80 1.000	0.0799 3.5040	0.1052 4.6140
Nageah, .. {	1.000 45.045	22.20 1.000	0.09324 4.200	0.12273 5.5282
Kanga Bassá, {	1.000 43.478	23.0 1.000	0.09324 4.0539	0.12273 5.3360

In Europe, a medical committee, solicited by different governments, proposed to mix $\frac{1}{1000}$ of ioduret of potassium with the salt destined for the daily use of the mountainers afflicted with the disease, or living in places where the infirmity exists.

Here nature offers this remedy ready formed, and in larger proportions without the excess being injurious; besides there is a chance of finding a sufficient quantity of salt to render it profitable in a commercial point of view.

558.—[273]. Ainlé (?) spring.

559.—[274]. Bassá spring.

560.—[275]. Mineral water, from Bohan.

Traces of an excavation are shown, which is stated to have been made in the time of Sansár Chand, the Katoch sovereign of Kangra, in the hope of reaching the deposit of salt in which the springs were supposed to take their rise. It has, indeed, been stated that the percentage of saline matter varies slightly in the different springs, and also that the amount of saline matter thrown up increases in the rainy season. These facts, if they are correct, tend to show that the source of the salt is not far from the surface; still it is the opinion of CAPT. HAY, and is indeed the conclusion that is the most coinci-



dent with geological considerations, that the source of the springs is not in any workable deposit of salt such as are found in Mandi. It may be added that, while the Jawálá Mukhí waters contain a large percentage of iodine; DR. FLEMING states as the result of his analysis that not a trace of it can be found in the rock salt of Mandi.

561.—[276]. Mineral water, from Kohalla.

The people of the neighbourhood use the salt obtained from the evaporation of the water as alimentary salt, and the springs are largely resorted to by persons afflicted with goitre, for which iodine is a well known remedy.

562.—[277]. From Jivali spring, Bara Bungali.

Elevation 4,500 feet. MR. MARCADIÉU, geological surveyor, reports that this water contains bromium, probably as bromide of sodium. The following are the results obtained from 40,000 parts of saline water.

Bromide of sodium,	0.48
Or from 1000 parts of saline water,	
Bromide of sodium,	0.012

563.—[714]. Water from hot springs at Jaura. MR. GEO. JEPHSON.
Simla.

564.—[715]. Saline deposit from do.

565.—[716]. Sulphur deposit.

566.—[872]. Saline deposit from a spring on the road, a few miles from Dalhousie. MR. B. POWELL.*

* The saline deposits examined consisted chiefly of carbonate

567.—[873]. Water from the sulphuretted hydrogen spring at Danera.

This spring is considered sacred by the natives, who resort to it for cure in goitre and other diseases; it is situated about a quarter of a mile off the main road to Danera. The narrow pathway which leads to it has been years ago rudely paved with stones; the spring itself is confined by an artificial tank of stones, in which the water rises up with bubbles of the strong smelling sulphuretted hydrogen, and trickles over the edge of the tank into a shallow stream, whose course is marked by the abundant white fur-like precipitate, which covers the stones, leaves, &c., over which the water passes, and hangs in threads over the tank edge, where the water escapes. The water is not very clear, and its taste somewhat saline. The spring is not a thermal one, but its exact temperature was not observed. A small wayside spring in the hills, near Dalhousie, was observed to have a strong chalybeate taste, and deposited the reddish precipitate indicative of iron. No. 874 showed a leaf and a stone covered with the white deposit alluded to.

568.—[964]. Bottle of bitter water, from a well in the Faridkót fort. H. H. THE RAJA OF FARIDKOT.

of lime and sesqui-oxide of iron, deposited owing to the escape of the carbonic acid.

The water, No. 872, from Danera, was examined: no trace of sulphate of hydrogen remained at the time it was analysed, but a considerable amount of carbonate of soda, with some carbonate and sulphate of lime.

The sample was not sufficient in quantity to determine the proportions of these ingredients.—DR. B. BROWN, Chemical Examiner, for the Punjab,

SUB-CLASS (B) RARER SUBSTANCES USED BY THE SCIENTIFIC CHEMIST.

THERE is scarcely any substance exhibited to represent this Sub-class. Borax may be mentioned as used for a flux in experiments with the blow pipe, and there is one other,—

569.—[866]. “Lotá khār.” Lahore bazar. RAM SINGH, Pansári.

A very impure cyanide of potassium. The salt is so impure that it does not contain more than about 2 per

cent. of the cyanide. It is made by fusing yellow prussiate of potash with carbonate of potash : it is used to form a solution with nitrate of silver for electroplating.

This concludes the collection under Divisions III. and IV. The report of the jury follows. The Divisions III. and IV. are very similar as to the nature of the substances they include, and most of the substances in the former, whose prominent use is in some art or manufacture, have also medicinal virtue in the Native Pharmacopœia ; hence the two Divisions are appropriately classed together for consideration by the same jury. The distinction between Divisions II. and III. has been based on the employment of the term Chemical Substances to signify substances that are compound in structure, such as metallic salts, oxides, &c., and not simple minerals as sulphur, asphaltum, or plumbago.



REPORT ON MINERAL DRUGS.

SECTION A. CLASS II.

DIVISIONS III. AND IV.

DIVISION III. CONTAINING CHEMICAL SUBSTANCES USED IN MANUFACTURES; AND DIVISION IV., CHEMICAL SUBSTANCES USED IN MEDICINES.

JURY.

W. GREEN, Esq., M. D., <i>Deputy Inspector General of Hospitals.</i>	J. PENNY, Esq., M.D., <i>Civil Surgeon, Lahore.</i>
H. ELTON, Esq., M.D., <i>Medical Store-keeper.</i>	B. POWELL, Esq., C.S., <i>Curator of the Museum.</i>
J. B. SCRIVEN, Esq., M.D., <i>Principal, Medical College, Lahore.</i>	J. BARTHELEMY, Esq., <i>Apothecary to the Citadel.</i>
A. M. DALLAS, Esq., <i>Inspector General of Prisons.</i>	

The jury called as Assistants for the Vernacular—

RAM SINGH, *Drug Merchant.*

BASHI, *Manufacturer of Acids and Chemicals.*

REPORTER—DR. BURTON BROWN, *Chemical Examiner.*

These divisions are invested with considerable interest, both by the fact of their including many substances, such as nitre, borax, antimony and sulphur, which are of great economic value; and also by their indicating to what extent substitutes for European medicines can be obtained from the bazars: at the same time they show the various substances which the native practitioners of this country are in the habit of using in lieu of the purer, and therefore more efficacious remedies of English medicine.

In the mineral division of the Pharmaceutical Section there were 247 specimens.

The Lahore collection alone contained as many mineral drugs as were obtained from all the other districts united.

The following substances deserve especial notice.

SULPHUR.

Several specimens of different kinds of this remedy were sent: in particular a fine colored specimen, No. 878, from Lahore; and a piece of sulphur in its matrix, No. 907, from Shah-pur: a considerable amount is to be found in the Salt range. This substance is very valuable both as a medicine and in chemical manufactures.

WATER.

The mineral waters exhibited were principally those of the hills of the Kangra district; containing saline matter, and in some cases iodine; some white deposits on leaves and stones, Nos. 872 and 874, were sent from Dalhousie, and included in the Lahore collection. These proved to be carbonate of lime and sesqui-oxide of iron, which were probably precipitated, as the carbonic acid which held them dissolved in the water escaped into the air. Only one of the specimens remained for examination, No. 873. This proved to be an alkaline saline water, but it contained when examined, no sulphuretted hydrogen.

SILICA.

Several minerals composed of this body are still included in the Native Materia Medica, though it has long been known in European practice to be inert. The principal ones, were carnelian, (No. 820,) from Lahore: (native name, 'akik:) agate, (No. 823,) also from Lahore, called sang-i-Salaimāni; flint (No. 821,) "chakmak," and sand, (No. 877,) "ret." The carnelian was employed on account of its red color, resembling that of the blood; it being formerly thought that medicines had indications in their physical properties and appearances of the purpose for which they should be used.

SAL AMMONIAC—NAUSHADAR.

Numerous specimens of this important salt were sent: a good clean salt from Lahore, (No. 854,); another from Gujranwalla (No. 894). This salt is said to be obtained by burning bricks made of clay, which is full of organic matter, from the bottom of certain ponds; and is believed to be formed by the decomposition of the aqueous vapour by contact with red hot bricks in the presence of air. The crude salt so obtained is refined by sublimation. An interesting specimen of the vessel in which this operation is performed is shown, No. 18, Kurnal. It consists of a thin glass vessel, with a nearly globular body, and a long wide conical neck, and is coated externally with clay to prevent its fusion by the heat which is applied. Sal ammoniac is not only valuable as a medicine by itself, and might probably be used more than it is with good results in our dispensaries; besides this, it is important as a source of most of the compounds of ammonia, and is used at Lahore for the manufacture of solution of ammonia, for snake bites, to a considerable extent.

CARBONATE OF SODA—SAJJI MITTI.

An impure alkali, similar to the barilla, prepared in Spain and elsewhere, by burning plants containing soda salts. Sajji mitti is made by burning plants called by the natives "khār," and which appear to be various herbs belonging to the natural order Chenopodiaceæ, particularly the *Anabasis multiflora* and the *Coronylon Griffithii*. The ashes which fuse and run into a gurrah placed beneath the burning heap, are termed sajji lotah, and are considered purer. Sajji consists of about half its weight of carbonate of soda, mixed with clay, sand, and organic matter; also the sulphates of soda and lime, the chlorides of sodium and potassium, and the sulphide and sulpho-cyanide of sodium; the last salt may easily be extracted by boiling the mass with alcohol.

Sajji mitti would be a very available source of carbonate of soda for our dispensaries, but would not be worth exporting, as the pure salt is made so cheaply in England from common salt.



COMMON SALT—NIMAK.

Is exhibited both as salt, the produce of the mines, and as a medicine. In the former department there is rock salt of a dark color, sent by the RAJAH OF MANDI, from the Drang and Gumati mines; and from the Kangra district is sent some salt (impure) that comes from Ladákh, and is used in the higher parts of our hill country. From the great salt district, the country about Pind Dádan Khán, Shahpúr and Kalábágh, there is very fine set of specimens, some of which require especial notice. From Kathá, in the Shahpúr district, are sent fine cubical crystals of salt, perfectly colorless, as clear as glass; from the same mines are several other specimens of pure salt; from the Kheura mines, in the same district, are many pieces of pure massive crystallized salt, some slightly colored red, the coloring being due it is said to organic matter.

The salts exhibited in the Medicinal Department, consisted of very fine crystals. No. 863, from Lahore, was called "nimak shísa;" the crystals were, however, inferior to those in the Salt range collection; there were also several less pure specimens, as "nimak sámbar," (863,) "nimak sonchal," (860,) &c. Under this head also must be included "nimak siyah," or black salt, said to be made by evaporating a mixed solution of saji and salt, but the specimens sent contained no carbonate of soda, but were composed of chloride of sodium with sulphide and sulphate of that metal.

BORAX—SOHAGA.

This important salt was well represented by several good specimens from Amritsar, (No. 743,) and Lahore, (No. 852.) It is procured in considerable quantity in the Trans-Himálayan regions, from deposits on the edges of lakes, and is imported into England. Its use in medicine, though considerable, is limited; but it is of more service in the arts, both in forming glazes for pottery and to dissolve oxides of metals, thus facilitating their junction.

REH SALT.

A specimen without number, sent by Dr. Cookson from Muzaffargarh; it consists principally of sulphate of soda with a little chloride of sodium; it is in fine prismatic crystals very efflorescent, and might be used with economy in dispensaries as an efficient substitute for Epsom salts—sulphate of magnesia.

NITRE—SHORA.

Several beautiful specimens of this salt were shown, especially one called "kalmi shora," from the pen-like length of its crystals, from Lahore (No. 853.)

This valuable salt is extensively manufactured in many districts of the Punjab, being obtained from soils where animal decomposition is going on. Specimens were sent from a very large number of districts—Hissar, Rohtak, Ambálla, Ludhiana, Jalandhar. Amritsar, Lahore, Gujrát, Shahpúr, Gugaira, Dera Ismaíl Khán, Dera Gházi Khán.

CARBONATE OF POTASH—JAU KHAR.

An impure carbonate of potash is manufactured from the stalks of the barley plant, by burning them and collecting the ashes; this, however, contains much of the chloride and sulphate of potassium and of carbonate of lime. A much purer salt is sometimes prepared by natives by heating wood charcoal with nitre, but no specimen of this is shown.

CYANIDE OF POTASSIUM—LOTA KHAR.

This salt is made at Lahore for the purpose of electro-plating, from the yellow prussiate of potash and carbonate of potash, but the product is very impure.

GYPSUM—SULPHATE OF LIME.

Of this a great number of specimens were given under very various names; thus No. 830, Lahore, is called sang-i-jaráhat; No. 834, is called godanti; No. 902, from Jhilam, is called "surma safaid," as also No. 897, from Rawalpindi. This latter name was probably given by mistake, as it is usually applied to the carbonate of lime; "makol," (No. 798,) is another specimen from Lahore. Sulphate of lime is more used in the arts than in medicine, it is particularly useful in the form of plaster of Paris, for casts, making stucco, &c.

NITRATE OF LIME.

No. 875, (Lahore,) was sent recommended as a probable chemical antidote for the salts of "reh." It has long been known among natives that the best remedy for reh is the saline efflorescence of old mortar in walls, or which appears on ground containing carbonate of lime and animal matter. In this substance nitrate of lime is found; and this salt would act by producing the insoluble carbonate of lime, and the sparingly soluble sulphate of lime, and the deliquescent nitrate of soda, instead of the efflorescent sulphate and carbonate of soda, which are the principal constituents of reh.

CARBONATE OF LIME.

Very many specimens of this were exhibited. Marble, (sang-i-marmar, No. 833,) opaque calcareous or Iceland spar, (surma safaid, No. 843,) and chalk, "kharya mitti." Others were primarily derived from the animal kingdom, as coral, No. 836, (from Lahore); fossil encrinites, sang-i-yahúda (No. 846 and No. 870, Lahore); also a minute fossil bivalve shell (Lahore); and nummulites, "sangcha," (No. 933,) from Dera Gházi Khán; and sang-i-shádnaj" (No. 847, Lahore); these are interesting as showing that the natives employ fossils as medicinal substances, which are less fit for use than ordinary chalk.

ALUM—FHITKARI.

Numerous specimens of this useful drug were sent. A very good crystallized specimen, No. 906, from Shahpúr, and two from Lahore, showing both the red and white varieties. This salt is manufactured in large quantities in the Punjab, from alum shale, of which a specimen, No. 905, was sent from Shahpúr, and also No. 936, from Dera Gházi Khán. The salt as found in the bazar is quite pure enough for medicinal use.

OCHRES.

Several specimens of ferruginous earths were exhibited under the names of geru, gil irmaní, Múltáni mitti, gil zard, &c., but these are no real service in medicine. The same remark applies to the specimens of glass, mica, and steatite; also granite, which will be further referred to in the Catalogue.

It may, however, be desirable to distinguish the various kinds of ferruginous clays used. No. 762, geru or gerí, is a hard laminated red earth, used as a dye for cloth.



GIL IRMANI.

The representative of the Armenian bole, a rough red but irregular mass, resembling "geru" in color, not used in European medicine, but formerly employed, and is still used by natives.

GIL-I-ABRORSHI.

A rough hard, not brittle, pink earth, only used in native medicine.

GIL ZARD.

A pale yellow tough laminated earth, intermediate in color between geru and gil Múltání; but resembling both in appearance.

GIL MULTANI—FULLER'S EARTH.

A soft laminated white or pale yellow earth, used by the natives for cleaning their hair, and in medicine.

GIL MAKHTUM.

A soft rough irregular variegated marl, containing clay, deeply colored by peroxide of iron, mixed with nearly white carbonate of lime.

GIL KIRIA.

A soft laminated, nearly white clay, resembling chalk in appearance, hence probably the name.

HASSAN DHUP.

A harder white clay. The real article is supposed to be a deposit (containing sulphur) from a mineral spring.

BINOXIDE OF MANGANESE—JUGNI OR INJNI.

A single specimen of this important mineral, so useful in making chlorine and oxygen, was shown from Lahore, No. 817; it is principally used at Lahore to remove the color of glass containing iron, and is said to be imported from Kashmír and Kábul.

OXIDE OF ZINC—MISSI SAFED.

An impure specimen of this drug, No. 800, was also exhibited by the Lahore Committee.

OXIDES OF IRON.

Several specimens of these were exhibited; one in particular, No. 803, was worthy of notice, as it was called "surma Ispahání." Several substances are often substituted in the bazars for sulphuret of antimony, and this was one.

SULPHATE OF IRON—KAHL.

This substance is said to be produced by concentrating the mother liquid, from which alumina has crystallized out, and it therefore contains much sulphate of alumina with sulphate

of iron, and other impurities. If the iron is chiefly in the state of protoxide, the color is greenish or white, and it is called kahi sabz or safed; but it mostly is peroxidised, and is then termed kahi zard, from its yellow color. Some specimens of kahi are also said to be obtained from the ground. Kahi lál consists solely of bichromate of potash, of English manufacture, and is principally used in dyeing. Two specimens of this were shown in fine crystals (No. 4355, Amritsar).

SULPHATE OF COPPER—NILA TUTYA.

An impure pale blue salt. Is prepared by boiling copper plates with sulphuric acid, and might easily be purified by recrystallizing; but there is also in most bazars some very pure sulphate of European manufacture, as No. 4523 from Amritsar, and No. 784, from Lahore.

ACETATE OF COPPER—ZANGAR.

One specimen, No. 785, from Lahore, was sent. This is said to be of English manufacture, but might be made by placing grape husks between copper plates. It is principally used as a coloring matter.

SULPHIDE OF ANTIMONY—SURMA.

This mineral is extensively used by the natives as an application to the eyelids, either solely for appearance or with other substances as a medicine. It has been already remarked that under the name surma many substances are supplied, especially the sulphuret of lead, the sesqui-oxide of iron, and occasionally bin-oxide of manganese; while the name "surma safaid" is usually applied to calcespar, carbonate of lime, and sometimes to sulphide of lime or gypsum.

ARSENIOUS ACID—SANKHYA.

Some very fine specimens of this deadly poison were shown, in particular one of vitreous arsenious acid, by B. POWELL, Esq. (No. 806); a large number of different compounds containing arsenic are shown.

ORPIMENT—HARTAL.

A very fine specimen of this substance divisible into thin plates, called "hartál warkí," was shown from Lahore; other specimens were more massive; varieties of this, called hartál pili and gulábi, were also shown.

REALGAR—MANSIL—BISULPHURET OF ARSENIC.

There were also several boxes of this poison; one kind naushádar kání, (No. 816,) Lahore and (No. 753) Amritsar, deserves especial notice, as it might be confounded with sal ammoniac by its name, and lead to injurious results.

OXIDE OF LEAD—MURDA SANG.

This is said to be made at Lahore and Jágadri, and it might be well employed in making lead plaster (strapping) with some of the country oils; other preparations of lead also might be manufactured from it.



READ LEAD—SANDHUR.

A specimen of this, (No. 753,) and one of carbonate of lead, or safaida, (No. 779,) were both shown from Lahore; but were probably manufactured in England.

MERCURY—PARA.

Two rather impure specimens of this liquid metal are shown, (No. 764,) from Amritsar; the other, (772,) from Lahore: they are chiefly important as a source of the preparations of this drug, namely:—

CALOMEL—RASKAPUR.

(No. 775, Lahore). This is a very pure specimen, quite free from any soluble corrosive sublimate, which is generally contained in bazar specimens of raskapúr, and often is present in poisonous proportions, unfitting such for medicinal use.

CORROSIVE SUBLIMATE—DAR CHIGNA.

Some very fine specimens of this powerful remedy were also shown, as No. 748, from Amritsar, and No. 775, from Lahore.

NITRATE OF SILVER.

A rather dark looking specimen of this salt, which is now made at Lahore for photographic purposes in much purer form, was shown, (No. 842,) and called “kástak” (this term is a corruption of “caustic”).

LIGNITE—SALAJIT.

Several specimens of this fossil were shown as native medicines; they are without any real value for medicinal use.

PETROLEUM—MITTI KA TEL.

A fine specimen of this valuable fuel was shown, No. 876, from the Lahore Museum; if the experiments which are now being carried on in England prove that it can be used as a substitute for coal, this substance may become of the greatest importance; but at present its employment is extremely dangerous. In medicine it is chiefly employed to apply to the skin.

AMBER—KAHRUBA.

Two fine pieces of this substance were shown from Lahore.

MINERAL ACIDS.

SULPHURIC ACID—GANDHAK KA TEZAB.

(No. 888) is made at Lahore for the purposes of dissolving indigo, and the energetic native who prepares it has not only constructed a leaden chamber for the purpose, but has imported a platinum retort from England in order to concentrate it sufficiently. The acid is therefore supplied quite free from coloring matter, and of any strength that may be required; it contains however a quantity of sulphate of lead.

NITRIC ACID.

Is made in two ways in Lahore: the best by acting on pure nitrate of soda with a quantity of sulphuric acid. This sort is used for the purification of silver, and the formation of the nitrate. A less pure kind is made by the action of kahi (impure sulphate of iron) on nitre, but this is rather a mixture of nitric and hydrochloric acids, and will dissolve gold leaf. Both specimens are shown, No. 889 and 891, from Lahore.

HYDROCHLORIC ACID—NIMAK KA TEZAB.

Is made similarly to nitric acid, substituting common salt for the nitre.

The following substances included in the British or London Pharmacopœia are represented in a more or less pure state among the medicinal drugs present in the Exhibition.

English Name.	Native Name.	Remarks.
Sulphur,	Gandhak,	Of various qualities. Very impure.
Sal ammoniac,	Naushadar,	
Nitre,	Shora,	
Carbonate of soda,	Saji mitti,	
Common salt,	Nimak,	
Borax,	Shāga,	Very impure.
Lime,	Chūna,	
Sulphate of lime,	Sang-i-jarāhat,	
Carbonate of lime,	Kharya mitti,	
Binoxide of manganese,	Jugni,	
Zinc,	Jast,	
Oxide of zinc,	Missi safed,	
Iron,	Loha,	
Magnetic oxide of iron,	Chamak pattar,	
Sesqui-oxide of iron,	Hira kasis,	Of English manufacture.
Sulphate of iron,	Tāmba,	
Copper,	Nila tūtya,	
Sulphate of copper,	Zingār,	
Acetate of copper,	Kahi lāl,	
Bichromate of potash,	Sārma,	From England. Impure. Often contains sublimate.
Sulphuret of antimony,	Kala'i,	
Tin,	Sisa,	
Lead,	Murdā sang,	
Litharge,	Sandhūr,	
Red oxide of lead,	Safeda,	
Carbonate of lead,	Pāra,	
Mercury,	Rāskapūr,	
Calomel,	Dār chigna,	
Corrosive sublimate,	Kāstak (corruption of caustic),	
Nitrate of silver,	Hartāl,	
Orpiment,	Mansil,	
Realgar,	Sankhya,	
Arsenic,	Wark nukra or chandi,	
Silver leaf,	Wark tilā or sonā,	
Gold leaf,		

The above include all the specimens shown in this collection, which if carefully prepared and purified, would be of service either in medicine by themselves or to prepare other drugs with.



Among the prizes which the jury have to allot is one offered by H. H. RAJAH OF KAPURTHALLA of Rs. 200, "For any chemical preparation, cheap and simple, that shall effectually neutralise the saline ingredients so abundant and injurious in many parts of the Punjab, and render the soil culturable." The jury are of opinion that no preparation has yet been proved to neutralise the ingredients spoken of, and that they would recommend that his HIGHNESS THE RAJAH OF KAPURTHALLA should be requested to allow the prize to remain in abeyance until some effectual experiments can be tried, and that the prize should then be offered for any process that would accomplish the desired result. The jury strongly recommended that a silver medal be awarded for the very extensive and carefully arranged collection of drugs from Lahore, and also award a prize of two shares for the mineral acids exhibited in the Lahore collection.

In conclusion, the above review of the Mineral Medicinal products shown in the Exhibition, prove how greatly they might be improved by a little European instruction in Chemistry, and at the same time how ready some of the natives are to take advantage of the information which they possess already, and that they procure from England substances they are unable themselves to make.

Thus, in the first place it has been necessary to record that many salts, as carbonate of soda and potash, sulphates of iron and of copper, are only shown of native manufacture in an impure state, because the manufacturers are not aware of any cheap means of purifying these; nevertheless, attempts have been made to prepare several substances requiring a certain amount of chemical knowledge, such as nitrate of silver, cyanide of potassium, and the mineral acids; and, lastly, pure salts, as sulphate of copper, acetate of copper, and also carbonate of lead, chromate of lead, and bichromate of potash, are procured from England for use.

It may be thought by some that it would be cheaper to manufacture all medicinal agents in England than to make them in Lahore, and probably this may be the case if they are only used in medicine, and are capable of being conveyed in a solid form; but there are several substances which are either required in larger amount, since they are used in the arts—such as alum, the mineral acids, sulphate of iron, carbonate of lead, the oxides of lead, vermillion, &c.; or they are liquid and therefore difficult to convey a long distance by land, as must necessarily be the case in the Punjab—such are sulphuric acid, hydrochloric acid, nitric acid, acetic acid, and solution of ammonia: all these could be made with probable advantage at Lahore; also there are many impure salts shown which could be readily rendered more pure, and therefore more useful. Should a school of arts be formed at Lahore, it is to be hoped that arrangements may be made in the shape of furnaces, &c., to instruct some of the more energetic "pansáris" of the city at that establishment, in the necessary processes for preparing these and similar substances. During the Exhibition several were anxious to enquire respecting the manner in which preparations from England, shown in this collection, were prepared, and what precautions ought to be taken in order to manufacture similar specimens; and much benefit might result if suitable instructions were given.

T. E. B. BROWN, M.D.,

Reporter.

Division V.—Substances illustrative of the Geology of the Province.

SUB-CLASS (A). FOSSILS.

THE reader will kindly remember that the following brief and imperfect notice of a few of the fossils sent to the Exhibition of 1864, makes no pretence of being scientific or complete: it is indeed obvious that the list only includes a very few of the species either of Mammalian and Molluscous remains which are to be found in the hills of the province; besides this, there are large tracts of country whose fossils and rock formations are entirely unrepresented. I debated for some time whether these sections ought to be printed, but eventually I determined to let them stand, principally from unwillingness to exclude from mention, the interesting collections of MR. PHILIP EGERTON and DR. COSTELLO.

In the same way, the geological sketch of the Punjab hills which follows, is solely intended to convey a brief and general idea of the hill formations to the unscientific reader, and to indicate the direction in which he may pursue the study of the subject. If it falls into the hands of a geologist, I must beg of him to forbear criticism on so imperfect a delineation. The geology of the Himálaya and its subsidiary mountain ranges might form the study of a lifetime, without being exhausted. Certain parts of this vast chain of mountains have indeed been studied, especially the lower formation of the Siwálík range, in connection with which the names of FALCONER and CAUTLEY are familiar to all. Other portions of the Himálaya, together with the hills beyond Peshawur, the Safed Koh, Hindu Kúsh, and Sulaimání ranges, are almost unexplored, and the only published accounts of their geology are to be found in a few scattered and brief notices in the travels of VIGNE, JACQUEMONT and others, and in several papers of the Asiatic Society. The same is true of the hills in the Delhi and Gurgaon districts; the geological age of which has not yet been determined. At present, therefore, the materials at command for compiling a sketch of the geology of the Punjab are but imperfect; and this fact may also be adduced as an apology for the imperfection of this division. Among the fossiliferous districts the only ones represented are;—to the north, the Spiti ranges, and lower down the Siwálík hill range, at Haripúr, Sujánpúr, Nadaun in the Kangra district, and several places in the Ambálla and Hushiyarpúr districts. Further west the hills about Simla are sparingly represented. The whole district thence onward to Peshawur and the Hindu Kúsh is quite unrepresented. The Salt range, which runs transversely between the Jhilam and the Indus, is not represented as far as its fossils are concerned, unless the Baloti range, and Shaikh Budín hills are considered as a portion or continuation of the range Trans-Indus; it is, however, from these lower hill spurs, that the finest series of fossils is exhibited. These hills lie in the vicinity of the Salt range; having those hills on the south, the Peshawur hills on the north, and the end of the Sulaimán range with the Wazírí hills on the west. From this place onwards down the western frontier, the branches of the Sulaimán range are occasionally represented. Dera Ghází Khán exhibits several fossils, from the Lagárá Mazárá, and lower hills belonging to the Sulaimán system.



On the other border of the Punjab territory, but not geographically within it, come the hills of the Delhi, Gurgaon, and Hissar districts. These are the systems of low hills known as the Delbi hills, beginning to the south-west of the district; they also to some extent, include the Shekawati hills, which form a portion of the Gurgaon district, and are eventually confused with the Aravalli range. Some of these hills are fossiliferous, others yield metals;—the copper of Hissar and of Singháná in Gurgaon district, belonging to this series. In other portions marbles and freestone are found; and the Kalyána hills of Dádri, now included in the Jhind territory, furnish elastic sandstone.

Most of the stones exhibited are included in the previous divisions, on account of their economic value as building materials, &c.; and there remains for this division only the fossil series, and a few samples of boulder stones and unutilized rock, together with some curious lime formations of petrified substances, concretes, and stalactitic deposits.

The ranges of hills thus enumerated furnish not only the fossils, but the whole mineral products of the province. All the plain districts consist of an alluvial clay soil, the analysis of which is given in the sequel. The products of the plains are kankar, or calcareous concrete, which is dug for in the soil of almost every district in the province, and which supplies both a material for making roads and flooring, and also a substance from which lime can be made. Pottery clays for coarse earthen ware, tiles, &c.; and saltpetre, which effloresces from the soil, conclude the list.

570.—[205]. Fossils. MR. GEORGE JEPHSON.
Spiti Pass and Hills.

I have no account of these.

[306—15]. Series of fossils from Spiti.
MR. PHILIP EGERTON.

The series consisted as follows:—

Belemnites.

Ammonites Gerardi,—Class, Encephala Cephalopoda oolitic?

Ammonites Nepalensis (Gray), do., do.

Ammonites triplicatus, do., do.

Ammonites Wallichii, do., do.

Ammonites bplex (Sowerby), do., do.

Ammonites torquatus (Sowerby) do., do.

Ammonites acucinetus (Strachey), do., do.

Ammonites, undescribed,* do., do.

Spirifer striata (Brachiopoda), carboniferous.

Productus—Sp. (Brachiopoda) carboniferous.

Pholadomya (Acephala), oolitic.

Nucula cuneiformis (Sowerby) (Acephala), oolitic.

Rhynchonella cynocephala (Brachiopoda) carboniferous.

Orthoceras? (Cephalopoda), carboniferous.

Astarte major, (Acephala), oolitic.

MR. EGERTON'S collection is from Spiti and

the Peen valley, at elevations of from 15,000 to 17,000 feet.

SIWALIK HILLS.

571.—[183]. Fossil bones. Sirmúr.
THE RANA OF SIRMUR.

Simla.

572.—[198]. Ammonites and sea shells, village of Themar.
MR. S. BERKELEY.

573.—[267-68]. Fossil shells, from Haripúr, Núrpúr, and Nadaun. LOCAL EXHIBITION

COMMITTEE.

The series [267] from Núrpúr, contains some very recent fossils. A species of *Unio* closely resembling the ordinary river mussel, in which both the epidermis and under pearly substance is completely preserved, is among the series, as also a number of spirals. There is also a species of *conus*.

The series from Núrpúr also embraces a number of fossil bones; some portions of the scapula of a small animal, the tread of tibia or ulnus of some animal; several portions of ribs. There is also a portion of a bone, hollow, and having a black color, which looks like the bone of a bird.

574.—[173]. Fossil bones, &c., Náhan.
LOCAL EXHIBITION COMMITTEE.

Amballa.

* This might be provisionally called *A. Egertonii*.

SULAIMAN RANGE.

This series is very poorly represented, nor has the range yet been explored: the vicinity of wild marauding tribes renders geologizing perilous.

575.—[542]. Fossils, from Lagári hills.

Dera Ghazi Khan. IMAM BAKHSH KHAN.

Consisting of *Belemnites*, a species of *Natica*, and several species of *Echinus*. The curious trilinear markings on the latter, are compared by the people to the impression of a bird's foot: to which, accordingly, they attribute the origin of these fossils. Among the fossils were included a series of stones which are not organic, but had been worn into singular shapes by the action of water.

[]. "Sangcha," nummulites. Mazári hills. IMAM BAKHSH KHAN.

The natives have a story with regard to the larger fossils of these hills, that they are the petrified clothes of fifty betrothed virgins, who were once surprised while bathing by their future husbands; they prayed heaven to grant them a covering; in answer to this the earth swallowed them up, and their clothes became stones!

SHAIKH BUDIN HILLS.

576.—[17-99]. Series of fossils from the Sand Hills, which run eastward from Shaikh Budin towards the Indus. C. COSTELLO, Esq., Assistant Surgeon, 6th P. N. I.

These sand hills rise somewhere east of Shaikh Budin in the Marwat Iláka of the Dera Ismail Khán district, and run northward parallel to and along the banks of the Indus, until they meet with the same series belonging to the Salt range.

- | | |
|--|-----------------------|
| Pith of fossil tree, | } (Monocotyledonous). |
| Outer bark of ditto, | |
| Inner bark of ditto, | |
| Head of thigh bone of a large mammalian. | |
| Head of a mammoth (<i>elephas primigenus</i>). | |
| Detached teeth of ditto. | |
| Portion of head of an elephant. | |
| Head of mammoth. | |
| Humerus of a large mammalian. | |
| Hip bone of a large mammalian. | |
| Sacrum of ditto. | |
| Upper portion of sacrum. | |
| Sacrum of a mammalian. | |
| Portion of coccyx of ditto. | |

- Lower extremity of femur of ditto.
- Head of humerus of ditto.
- Portion of head of a mammalian, probably a temporal bone.
- Portion of ribs of a large mammalian.
- Ditto of tusk of an elephant.
- Patella or kneecap of a large mammalian.
- Lower end of humerus of ditto.
- Lower end of tibia of ditto.
- Upper end of ditto ditto.
- Lower end of radius.
- Ditto of femur.
- Vertebra of a large mammalian.
- Atlas, or 1st cervical vertebra of ditto?
- Axis, or 2nd cervical vertebra of mammalian?
- Scaphoid bone of ditto.
- Astragalus of a large mammalian.
- Tooth of mammoth.
- Fossil sternum.
- Tooth of *Bos* sp.—?
- Portion of jaw of some herbivorous animal *Eos* sp.—?
- Tooth of ditto.
- Molar tooth of *Hippopotamus Sivalensis*.
- Tooth of *Dinotherium* (Kálábágh hills).
- Portion of horn of a deer.
- Portion of horn or tusk.
- Portion of jaw of a herbivorous animal.
- Portion of fibula of a mammalian.
- Vertebra of ditto.
- Lower end of fibula of ditto.
- Ditto of radius.
- Portion of a phalax.
- Portion of tusk.
- Lower jaw of some carnivorous animal.
- Another portion of the above.
- Pieces of teeth of the above.
- Soft sandstone from which the above fossils were procured.
- Coprolite (?) This appears to be a stone worn by weather, and looks like a coprolite, but is not organic.
- Belemnites.
- Several species of *Pecten* or *Janira* (species undescribed).
- Cidaris Verneuilii* (tertiary), Echinodermata.
- Terebratula* sp.—?
- Shelly limestone, with *Rhynchonella pleurodon*; foot of the hills on the Pannýála side (oolitic?)

BALUT RANGE.

577.—[80-100]. Collection by DR. COSTELLO.



Productus Costatus (Class, Brachiopoda), carboniferous.

Productus cora, do. do.

Athyris Roissyi (Leveille), do. do.

Athyris subtilita var *grandis*, do. do.

(Davidson, Quar. Journ. Geol. Soc. Lond. 1862, p. 23, pl. I. fig. 7-9).

Orthis resupinata (Class, Brachiopoda), carboniferous.

Rhynchonella pleurodon, do. do.

Rhynchonella sp.—? do. do.

Rhynchonella cynocephala, do. do.

Spirifera striata ? do. do.

Spirifera sp.—?

Streptorhynchus crenistria, do. do.

Streptorhynchus pectiniformis, do. do.

(Davidson, Quar. Journ. Geol. Soc. Lond. 1862, p. 30, pl. I. fig. 17).

Lithostroton irregulare (Zoophyta), carboniferous.

Ceriopora sp.—? (Bryozoa), carboniferous.

Anomia Lawrenceana (Acephala) carboniferous ?

(De Koninck, Quar. Journ. Geol. Soc. Lond. 1863, p. 6, pl. IV. fig. 7, 8, 9).

Lima gigantea ? (Acephala), oolitic.

Pecten (or *Janira*) sp.—? (Acephala), oolitic ?

Venus subaglaurea (Davidson), (Acephala), tertiary (Shaikh Budin).

Natica Flemingii (Sakesar in the Salt range) (Eucephala Gasteropoda), tertiary.

[It should be remarked that almost the entire collection of shells and zoophytes was wrongly named in the original Exhibition list. The identifications here given are chiefly by DR. OLDHAM.]



SUB-CLASS (B). MISCELLANEOUS SPECIMENS OF ROCKS, &c.,
NOT BEING AS YET OF ECONOMIC VALUE.

578.—[1]. Ferruginous rock. Sahi like "new red." Spiti. P. EGERTON,
Balabgarh. MUNICIPAL Esq.
Delhi. COMMITTEE.

579.—[]. Stalactites, from Spiti.

580.—[298]. Stalactites, from Suján-
púr Tera. LOCAL EXHIBI-
Kangra. TION COMMITTEE.

These are samples of a claystone covered with
a deposit of lime.

581.—[299]. Sample of a gray lime-
stone rock containing patches of carbonate of
lime, and containing hollows, the sides of
which are covered with quartz, in minute
crystals. Spiti. P. EGERTON, Esq.

582.—[305]. A pink sandstone,

like "new red." Spiti. P. EGERTON,
Esq.

The edge of the sample is waved in a curious manner
as if there were some fossil remains, but the sample
is too small to discover.

583.—[552]. A number of small hard
round stones, from the
Bunoo. Wazirí hills.

584.—[559]. A series of rolled round
fragments of hard rock, incorrectly termed
in the original list, fossils.

585.—[447]. A sample of rolled,
quartz rock, from Bucha, Rawalpindi. Lo-
CAL COMMITTEE.

There are some other samples of river rolled stones,
from Gujār Khán and Káshí Walla.

GEOLOGICAL SKETCH.

HAVING now recorded the specimens included in the collection, I proceed to a brief sketch of the physical geography and geology of the mountain ranges of the Punjab. Such a sketch seems almost necessary in connection with a class of mineral products derived from various localities, and which, unless the reader is put in possession of an outline showing the relation of one place to the other, would appear to be a mere miscellaneous series without any internal order or relationship.

The hills to be considered are first—The *Himálaya*, or properly speaking the portion of the western *Himálaya* which bounds the Punjab; this will include the secondary formations of Spiti and the *Kuenlun* range; next the subordinate group of hills, and especially the fossiliferous strata of the *Siwálik* and corresponding formations; next the *Salt* range, and the geologically related hills of *Kalábágh*, *Shaikh Budín* and *Balút*. Then come the *Sulaimán* hills, and the hills of the *Safed Koh* (*Peshawur* district); and lastly, on the other side of the province altogether, the hills of the *Delhi* and *Gurgaon* districts.

And first of the *Himálaya*:—The great mountain barrier to the north of our Indian empire is well known by the name of the *Himálaya* or *Himáleh*. It consists not of one but of a vast series of ranges; those towards India form the *Himálaya* proper; those towards Tibet and Central Asia, forming the *Kuenlun* or Tibetan chain still loftier than the *Himálaya*.

The *Himálaya* includes only those mountains below the line formed by the *Indus* and *Brahmaputra* rivers. A glance at the map will show that these two rivers rise close to each other, but flow in directly opposite directions, forming a long line till at either end of the chain, each river turns abruptly south; these form the limits of the *Himálaya* proper. It may be generally remarked that the secondary chains on the south face are of much greater importance than those on the north.

Thus defined, the *Himálaya* may be divided into eastern, central, and western ranges. It is the latter division alone that is immediately connected with the Punjab, and which can be taken into present consideration.

To any one desirous of obtaining a general brief sketch of the eastern *Himálaya* as a chain, I would

refer him to the Introduction to *DR. ROYLE'S Illustrations of Himálayan Botany*; to the Introductory Essay to *HOOKE*R and *THOMSON'S Flora Indica*; and to a valuable, but not easily obtained, paper by *MR. HODGSON*, on the Physical Geography of the *Himálayas*, published in the Asiatic Society's Journal, August, 1849, No. XXII. Besides these, I need only allude to the books of *CUNNINGHAM*, *HERBERT*, *STRACHEY*, and *HOOKE*R; as well as for general information, apart from geology, to the travels of *HUGEL*, *BURNES*, *STERLING*, *VIGNE*, *JACQUEMONT*, *GERRARD*, and others.

The chain of mountains on the north-east of the Punjab is also partly Tibetan partly *Himálayan*.

Taking as our starting point the great peaks* above the *Mansarowara* lake, near the 82nd parallel of longitude and 31st of latitude (roughly estimated); we find a marked chain, containing the *Karakorum* mountains, running north-east. This range forms the northern boundary of the provinces of *Balti*, *Nubra*, *Pangong* and *Nari-khorsun*. Another range below this forms the boundary of the provinces *Guge*, *Ladák*h and *Dras*. Below this runs the *Indus*, and then, enclosing the valley of the *Indus*, is another chain, which forms the boundary of the provinces of *Dras*, *Zangskár* and *Parang*; below these is the central range of the real or Indian *Himálaya*. Between the ranges, just mentioned, there are of course a vast system of subordinate chains varying in height. It may be remarked with regard to these, that the subordinate ranges exhibit much greater tendency to parallelism than to the normal idea of subordinate chains forming principal valleys at right angles to the main axis. This was noticed many years ago by *JAMESON* in his examination of the mountains between *Bhár* and *Simla*.†

The main range of the western *Himálaya*, commencing about *Mansarowara*, and running north-east,‡ terminates at the great peak (20,000 feet) of *Dáyámár*, or *Nanga Parbat*. Here the range rapidly sinks to—

* Natives call all the high snowy peaks of the *Himálaya* by the generic name *Kailása*. Hence the "*Kailás peak*," is rather unfortunate as a specific denomination.

† Remarks on the Geology of the Country between *Bhár* and *Simla*; see also Introduction to *ROYLE'S Illustrations*, p. xvii.

‡ Introductory Essay *Flora Indica*, p. 190.

wards the Indus. At this point also the two ranges which enclose the Khágán valley (traversed down the centre by the Nainsukh river) strike off in a south-eastern direction, and separate the Himálaya from the system of the Hindu Kúsh and Safed Koh, beyond and below it. Of the latter ranges I shall speak presently.

The central range of the west Himálaya runs nearly parallel to the Indus, and some distance south of it. The provinces which it bounds are Kanáwar and Spiti, Lahaul, Kishtwár, Kashmir, and near the Indus the tract of hill country represented by Hazara and Marri. The most remarkable pendant to this central chain is the vast chain of mountains, which, starting off near the 76th parallel of longitude at the Shesha-Nág peak, runs round, enclosing an irregular elliptical space, and rejoins the original range, midway between the 75th and 76th parallels. The amphitheatre thus formed is the Kashmir valley; the mountain ranges enclosing it, which form as it were a loop depending from the main line, are known by the name of the Panjál, or the Pir Panjál, the Snowy Panjál, the Panjál of Báníhal, &c., &c. This chain of hills separates Kashmir from Kishtwár on the east, and from Hazara on the west. The eastern portion of the central range, has another range parallel to it on the south, enclosing the Chandra Bhaga or Chináb, and forming the valley of that river between Kishtwár and the Tari pass, at the 78th parallel of longitude. The remaining subordinate ranges are more easily considered with reference to the rivers which run among them. First then, there is the Cis-Sutlej Himálaya, which runs downward towards the plains separating the Ganges basin from the valley of the Sutlej. Simla is situated in this chain. Next comes a series of hills bounding the valley of the Sutlej, and separating it from the valley of the Beás, including the Suket and Mandi territory. Beyond this, comes the Dhauladhár range (in which are Dharmasala and other well known places), separating the valley of the Beas from Chamba and the valley of the Ravi; and then a system, rather than a definite chain, of hills separating the Ravi from the Chináb.

Beyond the Chináb river and to the south of the great Kashmir valley, are a varied series of hills running off from the Panjál mountains, and forming the elevated country between the Chináb and Jhilam, including Rajauri. Beyond the Jhilam we have a continuation southward of that long mountain series which forms the Himálayan wall of the Khágán valley. On this is situated the well known hill station of Murree: this range may be taken as almost the limit of the Himálaya. Beyond this we have the whole hill country of Hazara up to the Indus.

This of course is only a highly generalized and

imperfect sketch of the chains of the western Himálaya. Besides the ranges, which I have indicated, there are endless subordinate divisions, some of which are so important as almost to obliterate (so to speak) the demarcation above adopted. No doubt the safest key to the intricate range is the principle of observing the valleys of the great rivers, and the ranges by which they are separated.

The published maps including the Himálaya, are a source of great difficulty to the student. Scarcely two of them are alike. This is a difficulty not easily got over, since it is obvious that if in the map only the principal ranges are given, each topographer will give what he considers to be the principal chains, and omit the details: consequently, as each man's view differs as to what are the principal chains, so will the maps differ; one puts in prominently what the other leaves out: hence the endless variety observable. Other maps again are so full of subordinate ranges strongly marked, that the whole Himálayan tract appears to be a net-work too intricate to distinguish one range from another. These are only difficulties of drawing; but if we take into consideration the actual inaccuracies of the maps themselves,—unfortunately only too common,—the confusion which results is incalculable.

It is impossible here to attempt anything like a systematic geological account of the mountains thus described, for the simple reason that until a regular geological survey of them is made, it is only in detached portions of the hills that we have the published accounts of individual observers, and haply a few collections of rocks and fossils to guide us.

The collections of the Exhibition of 1864, and those of the Lahore Museum, contain specimens from a few localities, showing the rocks which form the principal portions of the higher range of the west Himálaya. These consist of granite and syenite, and below that of talcose and chloritic schists and slates, and other metamorphic rocks, interspersed with dykes and interruptions of trap, amygdaloid, and various volcanic rocks, pebbles of which are found in the hill streams and in the beds of conglomerate in the lower ranges. Below these come tertiary formations of various sandstones and clays, as well of conglomerates formed of fragments of the metamorphic, volcanic and primary rocks of the higher ranges. These huge beds contain boulders often of immense size, which must have been transported by glacial agency; the conglomerate often forms whole cliffs cut into fantastic shapes by water action.

The secondary, oolitic, and carboniferous formations are mostly within the Tibetan mountains of the Kuenlun; in British territory they are solely represented from the little province of Spiti, which

forms the most north-eastern of British Himalayan possessions. These classes of rocks have been as yet but little studied in the Himalaya. The whole of the Sub-Himalaya ranges, through Rajauri, Jammú, below Chamba, Kangra and Simla, are entirely occupied by tertiary formations of sand, clay and conglomerate; and below these again, or more properly speaking, intermingled with them, are hills of fossiliferous tertiary formations.

It should here be observed that the fixed gradations of true Himalaya,—dhán or valleys,—sandstone or Sewalik range,—“bhayer” or forest tracts, and lowest of all the Farai, which consists of arid tracts or else swamps at the foot of the mountains,—which are so constant and marked in the central Himalaya, are not observable at all in the Punjab.

With regard to the sandstone range, intermediate between the true Himalaya and the plains, there is, no doubt, a range that must be considered *bonâ fide* Siwalik beyond the Jumna, which extends west of Nahan and Pinjor, as far as Rúpar, in the Ambála district. But we have no “dháns” and no “sál forest tract” (except slightly in Hushyarpúr and in Ambála). Below the true Himalayas come ranges of low hills, covered with brushwood, *Adhatoda vasica*, and other shrubs, which gradually subside towards the plains. Every one who has been through the Gurdaspúr, Kangra, Hushyarpúr, and Simla districts, will remember this. With regard, however, to those remarkable Siwalik fossiliferous ranges, it is quite true that here and there at very irregular intervals, tertiary strata having gigantic mammalian remains, characteristic of the Siwalik, may be found across the whole width of the Punjab, and can be traced through the Shaikh Budin hills, and the spurs of the Safaid Koh, even into the Sulaimán hills.

Thus, travelling from east to west, we find fossiliferous strata at Nahan (Ambála district) Nadaun, Haripúr, and Núrpur (Kangra), then at Kotli and throughout the Rajauri tract, including the Pabbi hills and thence onward to the Kálábágh hills, the Balát and Shaikh Budin hills, and the hills of the Lagári and Mazári tribes of the Derájat in the Sulaimán range.

The hills beyond the Indus, form a series of hills almost like a continuation of the Himalaya.

HUMBOLDT considers the Hindú Kush to be a continuation of the Kuenlun. DR. ROYLE remarks that from DR. GERRARD'S and LIEUT. BURNES' journey between Kábul and Báik, it appears “that the rounded nature and secondary formation of these hills rather resembles the (Tibetan) mountains to the northern of Kunáwar than the primary structured Indian Hima-

laya.”* These hills include the province of Gilghit, and below it Kuner; and indeed the hills beyond Peshawur, including the Bajaur hills famous for their iron, are but branches of the Hindu Kush. The range of hills below the Hindu Kush are the Safed Koh, from which numerous spurs descend, connecting the Sulaimán range and Bilúchistán hills.

It will now be proper to present a sketch rather more in detail, but still very imperfect, of the various hill ranges and their productions. Of the Himalaya, including that very large portion of it, which consists of primary, metamorphic, and non-fossiliferous rocks, I can here give no further account. Throughout the class of mineral products previously described, are to be found scattered notices of the granites, slates, sandstones, brought from various parts of it.

Of those parts of the chain, which are of secondary formation, we have but little knowledge. The Spiti province is alone the representative in the collection of these rocks; and to the description of this remarkable province I at once proceed.

Spiti* forms a valley in the extreme north-east angle of our territory, the inhabited portion is said to have an elevation of nearly 12,986 feet

The valley of Spiti was annexed principally with the view of preventing the evils which would result from allowing a foreign territory to intervene between the districts of Kangra, &c., and the wool producing valleys beyond.

“Spiti is approached,” says CAPTAIN HAY, “from our own territories and Kanáwar, by six different routes, and from Ladákh and Tartary by three routes, through the two chains of mountains; many of the passes are at great elevations, varying from 14,000 to 18,000 feet.”

Spiti is bounded on the north by the Parang range, separating it from Ladákh: to the north-east by inaccessible mountains; on the east, a valley called Kurateetakpo separates it from Chinese Tartary; on the south and west, it is enclosed by the portions of the snowy range, dividing it from Bishahr, Káfu and Lahaul.

There are three transverse valleys along these hill series, which constitute the whole of the inhabited portion of Spiti: one extends from the portion of the north-west range called Báláláchi, to the Bhúba pass in the direction of the curved line of mountains. About 30 miles of this valley are inhabited, from the river Spiti to the last village. Moodh, the second valley, extends from the Spiti valley in the direction of that

* MR. PHILIP EGERTON has recently published “A Journal of a Tour through Spiti,” which, besides the interest of the information contained in the letterpress, is further valuable from being illustrated with photographs taken on the spot.

curve of high mountains separating Spiti from Chinese Tartary. The third valley is known by the name Parang, from its leading up to the Parang pass.

The valley of Spiti is watered by the Spiti river, (whence it takes its name,) which, after flowing a considerable distance, divides into two branches. The Spiti is fed by several small rivers or streams, having their origin in the surrounding hills.

The following geological account, is extracted from CAPTAIN HAY's account previously alluded to.

"The formations that I have seen belong wholly to the secondary period: in fact, Spiti may be described generally as being of various kinds of lime and sandstone, with a few slates, shales and conglomerates. On descending into the bed of the Spiti after crossing the range which separates it from Kanawar, beds of red sandstone are first met with: in connection with these below Lara is gypsum and alum (sic) [alum shale?] From the water all the way from Lari to Dunkur being saline, I have no doubt but that rock salt may be discovered in the vicinity of the gypsum.

"These secondary strata contain some excessively interesting fossil beds, the first which I examined are in the Peenoo valley, and above the village of Mekeedon; they are a marine deposit, and belong to the "poikilitic" group, being situated between the beds of the lower new red sandstone and the magnesian group, or dolomite conglomerate; these again being associated with beds of shale and mountain limestone, point it out as an exceedingly likely locality for coal. The fossil beds of ammonites are of great extent, the shells varying from the size of a cart wheel, to an inch in diameter. In a very short time I collected as many as two men could carry, and could distinguish as many as six or seven different species of ammonite with a variety of other shells, and one or two vertebræ of fish.†

"A large quantity of red earth (red oxide of iron) is found somewhere in the vicinity, which is used by the people for ornamenting their houses and marking their sheep, &c.

"The other fossil beds which I examined are in one of the valleys near the village of Gicumull. The formation corresponds with the well-known lias and lower oolite, reposing on the lias. The mountain behind which these beds are situated, is composed of

a series of calcareous and sandstone beds, in an almost undisturbed position.

"The decomposing lias beds mixed with much indurated mud clay, and generally tinged with iron, have greatly the appearance of a coal field, and are on undulating hills; these are filled with ammonites of only one species. The decomposition of this group forms the richest ground in Spiti; the soil at Ladung and Lara seems also to be of this description, but the fossils are not so abundant. The lower oolite reposes on the lias, and is composed of rather complicated strata, containing immense quantities of shells in a black deposit of extreme fineness; this clay is perhaps an indication of the neighbourhood of coal. I procured a quantity of these fossils, consisting of a variety of bivalve shells, one or two univalves, and varieties of 'orthoceras' and belemnites.

"The mountain limestone is the most abundant formation in Spiti, and abounds with species of *Ammonites*, *Orthoceras*, *Spirifer*, *Terebratula*.

"Some of these beds may perhaps be attributed to the primary fossiliferous or silurian group. They are in a horizontal position, and have never been disturbed since their deposition, and they are in a dark gray argillaceous deposit, below which a slaty sandstone is met with; the fossils generally being *Pentameras*, *Tentaculites*, *Ammonites* and *Belemnites*, all indicative of the silurian group.

"The productive soil of Spiti is in general calcareous. As far as Ladung, it is of a light color; from Lee to Kee, the soil is blackened by the fossils; and above these places to the head of the valley, the soil assumes a reddish appearance, from its being more or less mixed with the decomposing siliceous particles of red sandstone. The soils are all light and easily turned by the plough; and would, if properly watered, be highly productive. It is a fact to be noted that Herbert, in his mineralogical survey of the Himalaya, travelled as far as the Hung Rung pass in Kunawar, and leaves it with a remark that 'limestone is never in these mountains a principal formation;' now the principal limestone formation is only there just beginning, but the whole of Spiti may be said to be a limestone formation: likewise a great part of Lahaul. Herbert also says, after mentioning the formations of gneiss, &c., 'that outside of the whole are very limited examples of secondary strata.' Now the secondary strata are of great extent, but not as observed by him. The secondary strata begin at the Hung Rung pass, which is a mere spur from the higher mountains, chiefly composed of limestone and sandstone, as the boulders in the river at Soongnum might have pointed out: but HERBERT merely sighted the limestone, and hence in my opinion drew an incorrect conclusion.

* See LYELL's Manual of Elementary Geology, p. 334 (ed. 1855). Where the term is explained.

† See No. 566, where the species of ammonites from Spiti are enumerated.

"The Bara Lacha and many other mountains, from 16,000 to 20,000 feet high, are secondary, though certainly very uncommon heights for secondary mountains. It will be a natural conclusion, that the whole range bounding the Tartar plains in this direction are secondary, or certainly not older, which would give us as great a breadth of secondary as of primary formation."

Next we are to notice the lower formations, including especially the Siwálik range.—This is a Sub-Himálayan range of the later or tertiary formation. What is strictly called the Siwálik, extends in a north western direction from the right bank of the Ganges, and runs parallel to the Himálayan range, forming the boundary of the Doab between the Ganges and Jumna; but the range, in reality, continues beyond this, and skirts the Ambála and Ludhiána districts, and comes to its termination in the Hushyarpúr district. Though this range alone receives the name of Siwálik, yet DR. ROYLE observes that hills of a precisely similar nature can be traced all along below the Himálayas from the Sutlej, as far as the foot of the Sikim hills: and it is not difficult to conceive a continuation of them more or less continuous, and of greater or less elevation, along the whole southern frontier of the Himálayan system, a distance of nearly 800 miles. At Hardwár, the Siwálik hills form the gorge at which the Ganges issues into the plains of Hindústán. The breadth of this range is at its widest part about 10 miles when it approaches the Sutlej river, and towards its termination beyond that river, the range assumes the form of little more than sand-hills. The highest part of the range is about Hardwár, and to the south of Garhwal, beyond Sirmúr, some of the peaks are as high as 3,000 or 3,500 feet above the sea level. The range is of tertiary formation—all alluvial, and in many places consisting of beds of gravel and rolled stones,—fragments of the older formations of the Himálayan range above, consisting of granites, limestone, clay-slate, gueiss, mica schists, &c. Besides these there are beds of loose grained sandstone,

with much mica interposing; there are also beds of calcareous conglomerate and subordinate beds of clay. On viewing these hills, it is difficult to avoid the opinion that they must have been vast beds formed by the débris brought down by glaciers and other causes from the high range above, and that these boulders and débris were empacted together with calcareous and ferruginous matters subsequently. In many places, the strata may be observed, rising one over the other, the face of one stratum resting on the slope of another, while another straight scarp rears itself on the slope of the first, and this frequently repeated, till on looking down on these abrupt ridges from a height, or viewing them from one of the numerous gorges which cut somewhat diagonally through the range, the appearance presented is that of the teeth of a huge saw.

The slope of the strata varies from 20° to 38°; the abutment being towards the plains on the south, and the slope towards the "dhún," or valley between the subordinate range and the true Himálaya.

The clay and sand beds of these ranges are fossiliferous: shells of the tertiary miocene period abound, but the chief characteristic fossils are the remains of gigantic mammalia, among which may be mentioned the Sivatherium, a huge creature somewhat similar to the "tapir" of modern days. The name is derived from the Hindu divinity Siva, which gives name to the Sivalik or Siwalik range.

The portions of the range represented in the Exhibition were the cliffs near the Markanda river, which forms the frontier of the Ambála district, and that portion which is included in the Simla and Kangra district, the localities being Nahan, the Sirmúr hills, and further on, Núrúpúr and Haripúr.

DR. FALCONER, on his first visit to the Siwalik hills, inferred that they were of a tertiary age, and analogous to the *Molasse*

of Switzerland.* Thirty years of subsequent research by other geologists has not altered that determination, although our exact knowledge of the formation has been greatly extended.

The researches thus begun were followed about the end of 1834, by the discovery by LIEUTENANTS BAKER and DURAND, of the great ossiferous deposit of the Siwaliks near the valley of Markanda, westward of the Jumna, and below Nahun. CAPTAIN CAUTLEY and DR. FALCONER were immediately in the field, and by the joint labors of these four officers, a sub-tropical mammalian fossil fauna was brought to light, unexampled for richness and extent in any other region then known. It included the earliest discovered *Quadrumana*, the *Pliopithecus*, and the *Dryopithecus*, an extraordinary number of *Proboscidea*, belonging to *Mastodon*, *Stegodon*, and *Elephas*; extinct species of *Rhinoceros*; *Chalicotherium*, *Equus* and *Hipparion*; *Hexaprotodon*, *Hippopotamus*, and *Merycopotamus*; *Sus* and *Hippohys*; the colossal ruminant *Sivatherium*, together with species of camel, giraffe, and new types of *Bovidae*; also species of *Cervus*, *Antelope*, and *Capra*; *Carnivora* belonging to the new genus *Sivalarctos* and *Enhydriodon*, *Drepanodon* (*Machairodus*), *Hyæna*, *Canis*, *Lutra*, &c.: among the *Aves*, species of ostrich, cranes, &c.: among the *Reptilia*, monitors and crocodiles of living and extinct species, the enormous tortoise, *Colossochelys Atlas*, with numerous species of *Emys* and *Trionyx*; and among fossil fish, *Cyprinidae* and *Siluridae*; no less than 25 species of shells occurred, all of which but four are now extinct. The general facies of the extinct fauna exhibited a congregation of forms participating of European, African, and Asiatic types. Thrown suddenly upon such rich materials, the ordinary means resorted to by men of science for determining them by comparison were wanting. Palæ-

ontological works or osteological collections in that remote quarter of India there were none. But Falconer was not the man to be baffled by such discouragements. He appealed to the living forms abounding in the surrounding forests, rivers, and swamps, to supply the want. Skeletons of all kinds were prepared; the extinct forms were compared with their nearest living analogues, and a series of memoirs by DR. FALCONER and CAPTAIN CAUTLEY, descriptive of the most remarkable of the newly discovered forms, appeared in the "Asiatic Researches," the "Jour. Asiat. Soc. of Beng." (Vol. III. to IX., inclusive), and in the "Geological Transactions."

The appearance of the lower or Sub-Himálayan range, in its relation to the higher or Himálayan series behind it, is well described in the Kangra district by MR. BARNES. As this fairly represents with more or less accuracy the whole aspect of the two ranges, with the intervening Dhúns or valleys, it will be interesting to transcribe his account:—

"To the north of the lowest range, the hills run into every variety of form and structure. Some rear themselves like mural barriers, and on the southern face present a wild and forbidding aspect. The crest too is rugged and angular, with scarcely room for the foot to tread. But the northern flank will offer the most striking contrast. The descent becomes gradual and easy, and the jungle and rocks which obstructed the traveller on either side, give way to open fields and farm houses, extending in successive tiers to the stream below. Such is the contour of the snowy range itself. Its appearance towards the plains is abrupt and perpendicular, while the northern spurs sweep in long and gentle slopes to the river Rávi. In other parts, again, the entire range will be covered with dense woods unrelieved by a single trace of civilized life; here and there on crags more than usually steep will stand a hill fort once the scene of border hopes and jealousies, but now a mass of dismantled ruins deepening the original solitude of the place. Occasionally the hills subside into undulating knolls, scarcely to be distinguished from the level of the valleys. Here the accessible character of the country has early attracted settlers, and the whole expanse teems with the fruits of human industry."

* Journ. Asiat. Soc. of Beng. 1832, Vol. I, p. 97.

"The distance intervening between these parallel chains is also capricious and irregular. The only valley with any pretensions to symmetrical arrangement is the Jaswán dhón, which is enclosed by continuous ridges from the Beas to the Sutlej, and maintains throughout an uniform breadth and surface. It is not in the Kangra district, but as a part of the same system, influencing and elucidating the other portions of the hills, I have frequently occasion to refer to it. The average width is about ten miles. The limits of the next valley, though less clearly defined, are distinctly traceable from Dutwal on the borders of the Kúlú to Shahpár on the banks of the Rávi. It runs the entire length of the district and traverses the pergunahs of Nadaun, Haripúr, and Nárpúr; at the south-eastern extremity the valley is little more than a ravine between the ridges that environ it. The surface is extremely rugged and broken, and from point to point is scarcely five miles broad; across the Beas, which intersects the valley at Nadaun, the space widens, and underneath the town and fortress of Haripúr expands into a noble and fertile plain, inferior only to the valleys that skirt the snowy range. Beyond Haripúr, the country again becomes contracted and uneven, and with few exceptions wears the same appearance until it reaches the Rávi."*

Before passing from the northern ridge of mountains, Himálayan and Sub-Himálayan, and coming down in the direction of the Salt hills, and their off-shoots, we must pause to notice that network of hills in the Peshawur district, to the north of the series, which will next engage our attention as the Salt range proper. The hills I allude to may be considered as off-shoots of the Safed Koh range, before described.

Between the Indus and the Swat rivers, the frontier is irregular, the spurs forming numerous smaller vallies, with others running up on both sides, and hemmed in by high precipices, in which secure nooks are located many of the villages of the occupying clans. The hills are for the most part bare, but the higher ones are fringed with pine, and the sides of others are scantily clothed with brush-wood; they afford however good pasturage for the cattle and flocks. In general it may be said that the vallies are intersected by numerous drains from the hills, the sloping banks of which are so perforated and cut up as to form a network of ravines, and a strong natural barrier against the approach of bodies of men not ac-

quainted with the locality. High cultivated ridges occupy the intervening spaces sloping down to these ravines; those nearer the hills being usually covered with a layer of loose stones. The plain outside these vallies is dry and level, with an alluvial soil, falling somewhat towards the Indus and Kabúl rivers, with a high tract of broken uncultivated land extending along the left bank of the latter. This plain forms, with the above vallies, the pergunahs of Yusufzai and Hashtnagar; a strip only from the Kabúl river at Naoshera to Bazar, on the Indus, being attached to that of Khuttak. The large villages of Hashtnagar are situated on the banks of the Swat river, and those of the Yusufzai lie chiefly towards the hills and on the Indus; the vast intervening plain, running from the Osman Khail hills to the Indus has but a few small hamlets: it is called the "Mehra," and is cultivated throughout, yielding with but little labor spring crops of great richness.

The Osman Khail and Momund hills, which latter form the boundary of the Doaba pergunah, lying between the Swat and Kabúl rivers are lower, and do not possess the bold and prominent features which mark those of Swat and Bonair. They are destitute of trees and have but scanty vegetation of any kind; a few shrubs are sprinkled about their base, chiefly olive or "kan." Bare, stony, and irregular, they rise abruptly from the plain; their ridges running parallel to the border and not forming vallies as in Yusufzai. Opposite Shabknddur, at Punjpao, they fall back and form an amphitheatre, occupied by a table land some 3 miles in breadth and 2 miles in depth: stony and intersected by some ravines. They retire again on approaching the Kabúl river, running nearly parallel to it for a few miles and meeting it at Michni. A "mehra" runs along the foot of these hills for their whole extent, varying in depth from 1 to 5 miles. Very little of this is cultivated, but it produces excellent pasture for the cattle of the villages.

From Michni to the Bara river, the Múlagarí and Afrídí hills are loftier, but bare and irregular as those of the Momunds. The Tarturra peak, over the entrance to the Khyber Pass, rises to a height of 6,000 feet, and from its summit may be obtained a view of that defile, and a large portion of the Ningrehar valley. The interior of these hills produces great quantities of firewood, but no large trees; their sides are rocky and precipitous. They present the appearance more of groups of mountains than of a connected chain, and from the western limit of the Khalil pergunah, which is bounded on the east by the Boodní stream, from Michni to Peshawur, and to the south by the Bara river.

From the Bara river to the Kuhat pass the hills of

* Barnes' Kangra Settlement Report, p. 9.

the Aka Khail, and thence to the Jawakai pass, those of the Adam Khail, form the western and southern boundaries of the Momund pergunah; further in they furnish large quantities of firewood, but are bare and rocky towards the plain.

The Khattak range continues the boundary to the Indus, maintaining an average height of from 3000 to 5,000 feet. The higher parts of these hills, though destitute of large forest trees, are clothed with smaller vegetation, consisting principally of the wild olive; the Khattak pergunah is an irregular mass of low hills, between this range and the Kabál river, a narrow strip of plain only occurring close to the latter, along which the Grand Trunk Road is carried; the villages are situated in defiles and on ledges amongst these hills, and cultivation is scanty.

DR. LORD was of opinion, from certain geological facts, such as the structure of igneous rocks, poured out under strong pressure, the presence of fossil shells, &c., that the vallies of Peshawur, Jelalabad and Kabál, were at some former period the receptacles of inland lakes; and that the drainage of these basins, now carried on by the Kabál river, was in those times effected by the bursting of the mountain barriers. He considered that the shattered fragments and rolled blocks, that strew the Khyber pass, bear testimony to its once having afforded exit to a mighty rush of waters, while the Geedur Gullee, a defile east of the plain, points out the course of the torrent towards the bed of the Indus. In support of this view, DR. LORD mentions the fact that a well sunk by the Sikhs in the fort of Jumrood, situated at the mouth of the Khyber, passed through rolled pebbles of slate and limestone (the constituents of of the Khyber range) to a depth of 200 feet; whilst the wells of Peshawur, 14 miles distant, are generally 20 or 30 feet deep, and never passed through anything but mud and clay strata. If the plain had once been the basin of a lake into which a stream had poured through the Khyber, the heavier matter with which the stream was charged, would have been deposited at its very entrance into the lake, while the lighter mud and clay would have floated on to a considerable distance.*

The Salt Range is a very well defined group of hills in its western and southern portions. Its elevation is inconsiderable, varying from 2,000 to 5,000 feet at extreme elevations; it is remarkably barren and scanty in its vegetation.

The name of Salt range has been given

from its productiveness of the rock salt at the mines of Kheura and other places, an account of which has previously been given. The range is known to natives by a variety of names; we have peaks called Karúli, Kundal, Sardi, Tilla, Bhulla, Kheura, Kas Gabbir, Kas Soj, Sangli and Chitta hills; together with many others both of the Shahpúr and Jhilam districts. The salt range generally, is called "Khawa."

This range runs across the Sind Ságar Doab, between the Jhilam and the Indus, crossing it from east to west, between the parallels 32° 22' and 33° north latitude, and 71° 30', and 73° 30' east longitude. It starts with three spurs or prongs, one on the east bank of the Jhilam and two on the right, both continue separate as far as the Búna nalla, which joins the Jhilam river at Dárápúr and Rasul, and then unite into one range, which continues up to Kalábágh on the Indus.

The first spur or range is on the east bank of the Jhilam, and embraces what are known as the Pabbi and Kharian hills. This spur continues across the river at Dárápúr, joining what is called the Saráfar hills, these are all of miocene formation, and continue up to the Búnah nallah, where they join with the second central spur, called Rohtás. This spur runs down to the Búnah nallah, crosses it under the name of "Chambal," as far as Jalálpúr, where it meets with the first spur, Kharian, above-mentioned. The third or most westerly spur is called Bak-rálá, runs parallel with the Rohtás spur, and then at the Búna nallah, spreads out forming the Diljabá ridge, and joins with the Rohtás and Kharian ridges, and from thenceforth the range is one. These three spurs are entirely of miocene formation, save that in the centre of the Rohtás spur, a portion of the Devonian series appears, in which is situated the Tilla mountain; in a certain portion also of the ridges, where the Kharian and Rohtás spurs meet, in the Chambal hills, both Devonian and eocene strata appear.

* Settlement Report of Peshawur district, by MAJOR JAMES.



At first the range runs west-south-west and reaching its most southern point at Fatihpūr, turns north-west again to Kālābāgh. From that place onward there is a continuation of the range to the north from the Chaunka and other hill series of Bunnoo and Kuhat; to the south the range is continued under the name of the Chichalli hills, which run nearly parallel in a southerly direction to the west bank of the Indus, as far as Isakhail and the Kúram river, after which comes a fourth, continued in the Kafir Kot and Shaikh Budín hills, forming the west bank of the Indus (the fossils of which are exhibited in the series of DR. COSTELLO) and terminate in a junction with the offshoots of the Sulaimán range.

The structure of this range may now be roughly but pretty accurately described, by saying that it consists of a series of belts of different formations,—Devonian, carboniferous, oolite, eocene and miocene, ranged in tiers; the base of the hills being formed on one side of the range by the Devonian, and on the other by the miocene; the other strata, carboniferous, oolite, and eocene, are ranged between, in the order I have named them, in those parts of the hills in which the whole series are exposed to view.

Starting at Jalálpūr at the foot of the hills, and close to the river Jhilam, and following the range in a west-south-west direction, we find the lower portion of the range skirting the "thal" or flat desert that intervenes between the range and the river Jhilam, consisting of rocks of the Devonian period. The series is visible along the entire range from Jalálpūr to Kālābāgh. Above this series comes the carboniferous, which however, does not run the whole length of the range as the other series do. Starting at Jalálpūr the carboniferous is not visible above the Devonian till we come to Núrpūr when it appears as a thin belt, and then on reaching the Khíri hill, an eminence 3,090 feet high, it widens out, and continues as far as the Vahi river and Musá Khail, where

the hills break. The carboniferous continues again on the other side of the break, and not far from the Indus near Kālābāgh. Then comes the eocene which continues all down the whole range, almost without intermission. From Jalálpūr as far as Núrpūr, owing to the non-appearance, as just mentioned, of the carboniferous, the eocene is above the Devonian; after Núrpūr, it is above the carboniferous and oolite.

The miocene strata form the base of the other (the north) side of the range beyond the eocene, and continue without intermission down the whole length of the range.

The oolite series only appears as a narrow belt above the carboniferous, and between it and the eocene, from Kālābāgh to the Gamúndra hills, near to the fresh water lake that appears in the highest point of the carboniferous formation in the vicinity.

The distinguishing features of these strata are that the southern, the Permian and Devonian, are the salt bearing series; the central the limestone, the débris of which forms a fertile soil; and the northern, form the miocene sandhills.

The southern side is described by DR. FLEMING as presenting "a jagged angular outline produced by a succession of points running towards the plain, and separated by deep intervening strata. These points are formed by, and in many places formed of, masses of rock and débris, which, during the upheaval of the Salt range, and subsequently from atmospheric and other disturbing agencies, have been detached from a high escarpment, with the strata of which they have undoubtedly been at one time continuous."

The small streams which run down from the hills, with one or two exceptions only, are saline, and instead of fertilizing the plains at the base, convert them into a "thal," or desert, which produces in some places, a stunted jungle of the *Capparis aphylla*, &c., but has scarcely any grass or cultivation.

The limestone ridge above, at a height

varying from 2,000 feet and upwards, where it exists as table land, is cultivated and productive, and when it is broken into ridges, it is still interspersed with cultivated valleys. On the limestone portions, besides the cultivation, the light green *Dodonaea* flourishes, and also the *Adhatoda vasica*, together with the phulahi (*Acacia modesta*) and the kau (*Olea*).

The northern district consists of low soft sandstone hills, devoid of cultivation, and abounding in the "falsa" or *Grislea tomentosa*.

I now proceed to a brief geological description of the strata-series above enumerated, premising that the sketch is only intended to serve as a guide to the mineral collection, which, exhibited from the Jhilmam and Shahpūr districts, and to some extent also from Bunnoo and Kuhat, represents the productions of the Salt range. The reader wishing for a minute account, should consult Dr. FLEMING's Report published in No. XXII. of the *Selections from the Public Correspondence of the Punjab Government*, and Dr. JAMESON's Memoirs in the *Asiatic Society's Journal* of 1843.

First, the Devonian series.*

The lowest beds are of a very red marl, which pass into argillaceous fissile beds of red clay, with red sandstone. Veins of gypsum traverse the marl, into the composition of which sulphate of lime largely enters; the red color is owing to peroxide of iron; thin beds of chert and siliceous sinter, with occasional patches of chalcedony also occur. In some places the marl is exhibited as a breccia, containing blocks of gypsum, salt, sandstone and limestone, which breccia was probably formed on the surface of the regular marl beds, at a period when the range underwent upheaval. It is remarkable about the marls, that they appear to have been burnt, and this is further established by the fact that in many places the gypsum they contain has been calcined into a plaster of Paris, and yet there is no indication of any plutonic rock throughout the range. The valuable products of the series, gypsum and salt, are mentioned under their appropriate heads in the collection.

This marl series is traceable from the beginning of the range in the Chambal ridge, and thence forward, sometimes disappearing for a considerable distance, and then re-appearing. From Jatana to Pind Dadan Khan the strata are uninterrupted then again go on to Musā Khail, and then again disappear, cropping out at Burakhail, and again at Kalābāgh, where they are extensively developed. At Māri and Kalābāgh, the marl has been subjected to violent disturbance, so that at the latter place, it might be supposed to be of tertiary formation, though its mineral character determines it to be of the same Devonian formation.

This marl then passes through beds like indurated clay to sandstone, which gradually loses its argillaceous character, and becomes lighter in color, and coarser, and sometimes passes into a grit. Bands of conglomerate also occur, containing moderate sized boulders of the older primitive rocks. The sandstone contains magnesia and carbonate of lime, and is not very good as a building stone, as it is hygrometric. No organic remains have been discovered in these series.

The red sandstone is succeeded by a series of greenish micaceous laminated sandstones, shales and calcareous beds, which in the eastern part of the range are developed, into an extensive deposit of sandstones ranging from dark gray to white, and weathering of a fawn color. The gray sandstones prove on analysis to be white siliceous sand held together with lime

Salt range. *Selections from the Correspondence of the Punjab Government*. No. XXII. p. 265.

PRIMARY.	Carboniferous.	Devonian.	a. Red marl with gypsum and rock salt.
			b. Lower red sandstone and grit with conglomerate.
SECONDARY.	Oolitic.		c. Greenish micaceous sandstone and shales with gray dolomitic sandstone.
			d. Upper red variegated sandstones, grits, conglomerates and clays.
TERTIARY.	Miocene? Eocene.		a. Lower limestone, calcareous sandstone, and shales.
			b. Gray sandstone and shales.
POST-TERTIARY.	Recent.		c. Upper limestone, sometimes magnesian.
			d. Yellow iron-stained quartzose sandstones, grits and bituminous shales.
TERTIARY.			e. Cherty thin-bedded limestones with shales.
			f. Green belemnite sandstones with shales.
TERTIARY.			g. Brown calcareous sandstone, nummulite limestone, marls and alum shales with lignite.
			h. Greenish sandstones, argillaceous grits, conglomerates, and red and green clays.
TERTIARY.			i. Alluvium.
			j. Alluvium.

* I subjoin for reference, DR. FLEMING's list of strata of the

and magnesia, sometimes the latter elements so predominate that the rock is almost a limestone; several samples of this stone occur in the collection: it is very durable. This formation forms the crest of mount Tila, and continues from Jalálpur to Makrách. It is in rocks of this class that the crystals of sulphuret of lead, exhibited from Karungli hill, are produced. No organic remains are visible in these strata. The sandstones are succeeded by upper red sandstones, dark red shales, argillaceous sandstones, and a quantity of grits. Red oxide of iron and magnesia abound, and the sandstones are ripple marked. Towards the Indus these strata are represented by colored indurated clays.

In these beds also copper ore has been found in nodular concretions, from mere grains up to the size of a walnut; they are of green color, and are observed disseminated through the clays; occasionally carbonate and silicate of copper appear. The ore is glance, an easily smelted and very rich ore: nothing like a vein has been traced. A pure specimen yielded on analysis in 100 parts:—

Copper,	75.830
Sulphuret of soda,	3.155
Sulphur,	21.000
Peroxide of iron and alumina,	0.15
	100.000

This is stated by Dr. Fleming to be a favorable specimen, and he adds the average yield would be 12 to 20 per cent.

The carboniferous strata come next in order.

At Musá Khail, Dr. Fleming made a collection of shells, which were sent home, and there identified as belonging to the carboniferous period. When the strata rest on the Devonian, they are gray calcareous sandstones; above this they are compact and crystalline limestones, varying in color from light flesh color to nearly black. In these beds sometimes occur masses of hornstone almost like flint. The limestones are fossiliferous, abounding in encrinurites and large brachiopodous mollusca; and in some places appear to be formed almost entirely of disjointed stems of encrinurites. Towards the Indus and in the Chichalli hills, the strata assume a magnesian character, and become devoid of fossils; the change is observed in several places.

Above these come beds of fine-grained fissile micaceous sandstone and beds of bituminous shale. Then come the beds of upper sandstones, only occasionally developed, forming the summit of the Zamáni hill. On the west bank of the Indus, in the Chichalli hills, the upper limestone is more extensively developed, and in the Kafir Kot hills, is repre-

sented by a brown bituminous sandstone, near which petroleum issues.

These carboniferous beds are all of salt water origin. The rocks of the series yield excellent building stones, and marbles, which take a fine polish. At Varcha the flesh-colored limestone could conveniently be quarried; and the black, near Kathá. The yellow argillaceous limestone of the upper limestone in the series, is said to be good as a lithographic printing stone.

Sulphuretted hydrogen springs issue in some parts, yielding sulphur deposits.

The fossils of the series are represented by *molluscs*, *crinoids*, *corals*, and *corallines*, Brachiopodous shells, *Producta*, *Orthis*, *Spirifer* and *Terebratula*, one or two *Gasteropoda*, and a *Cidaris*, have been obtained. In the upper part of the lower division of the series, the Brachiopoda give place to Cephalopoda, and *Bellerophon* and *Orthoceras* are represented; as also spiral univalves, *Cirrhos* and *Euomphalus*. These strata are remarkable for containing *Ceratites*, hitherto supposed to belong exclusively to the triassic group.

These rocks form a prominent feature in the range towards the Indus, and form the principal portion of the off-shoot Kafir Kot range, and it is probable that they occur in the Sulaimán range also. The series begins only at Núrpur, and attains its greatest breadth about Kathá.

Secondary oolite.—Fissile argillaceous sandstones, grits, and a quartzose sandstone, often colored yellow with iron, represent the group; also beds of shale containing iron pyrites. Masses of lignite occur also. Above this the sandstones become calcareous, and pass into fine grained cherty limestones, of variable color, containing very few organic remains. No distinct oolite structure prevails, but the limestones of this series are unlike those of the carboniferous, they are hard and have a conchoidal fracture. The dark varieties on being bruised emit a smell of sulphuretted hydrogen.

Throughout the Chichalli range, a singular calcareous bed appears of a brown color, containing globules of a bright metallic lustre, having the appearance of particles of hypersthene rock.

Then follow yellow quartzose grits of the sandstones, containing *belemnites* and *ammonites* in great abundance: the sandstone contains also quantities of iron pyrites which decomposes. This series does not yield any building stones, but only stones fit for lime burning. The series is not much developed save above Kathá, where the carboniferous strata expand, and thence onward towards the Indus. It does not occur at all near the eastern part of the range. The Chichalli range also contains the same kind of rocks all along. It is probable also that they are represented in the Sulaimán range.

Iron pyrites decomposed into "kahi" occurs in shales of this series. "Kahi" is largely collected at Musá Khail. The lignite occurs only in insignificant portions, except at Kálábágh, where there is a considerable quantity; some of the coals have impressions of ferns, &c. Clay iron stone occurs in small beds among the shales. The fossils of this series, besides ammonites and belemnites, are *Gryphaea*, *Plagiostoma*, and Saurian remains, chiefly teeth and bones.

Tertiary rocks.—These strata commence with bands of claystone, often ferruginous, and sometimes almost like pipeclay; resting on this is a greenish brown incoherent calcareous sandstone. At Kathá it gradually becomes more calcareous, and contains fossils—gasteropodous shells and nummulites. Westward to Musá Khail, the bed becomes arenaceous limestone, abounding in the fossils of the nummulite limestone series. Above this lie series of bituminous shales. These strata yield the alum shale, from which alum is made at Kálábágh. Iron pyrites and selenite crystals occur in the shales which are undergoing rapid decomposition; in some places, spontaneous combustion has set in. The shales above this become marly, and again nummulitic limestone occurs, and also a limestone which appears to have been formed by the strata breaking up on deposit, and then being re-agglomerated by the infiltration of calcareous mud.

Above the limestone are beds of an argillaceous character, then blue marls, and then more bituminous shales. Above these come beds of argillaceous limestone something like chalk; and above these are beds containing rows of flint, just like chalk flints. West of Pind Dadán Khán, the limestone generally forms the crest of the hills, appearing between that place and Kathá, and in the Chichalli range, as precipitous white cliffs, looking like chalk in the distance. The limestone is not suited for building stone, but is much used for lime burning: the boulders of it, which occur in abundance at the foot of the hills, are collected for the purpose. The minerals yielded by the beds are *alum*, *petroleum*, *sulphur*, and *coal*; all have received notice in their appropriate places.

The fossils characteristic of the series are, besides Foraminifera and nummulites, Gasteropoda of the genera, *Conus*, *Trochus*, *Olivæ*, *Mitra*, *Voluta*, *Terebellum*, *Natica*, *Neritina*, &c.; some large bivalves also occur. Cephalopoda are scarce; but species of *Nautilus* occur. Of RADIATA—*Spatangus*, *Galerites*, and *Clypeaster* were found. A few sharks' teeth and bones represent the VERTEBRATA.

These strata occupy a much larger portion of the range than any of the foregoing.

All along the eastern portion of the range, the eocene supervenes directly on the Devonian; after

this the carboniferous come between. These strata occur considerably on the southern portions of the Sulaimán range. Nummulitic rocks of a different appearance however from these have been observed in the Hazara hills, and this limestone has also been found in Kashmir. The remarkable extension which these beds have all over the old world renders them full of interest. Much yet remains to be done in tracing their extent in North-western India; at present no doubt a large portion of hill territory where these series occur are as yet unexplored by any geologist.

Later Tertiary Rocks.—These are referred provisionally to the miocene group. The first of the series is a bed of conglomerate, consisting of small rounded boulders of limestone, similar to that of the eocene period just described: this passes into a series of soft greenish sandstones alternating with beds of conglomerate in which small boulders of plutonic and metamorphic rocks predominate. These bands are numerous at Kálábágh, where there are boulders of a black stone (melaphyre). The sandstones are calcareous, and contain also tritubed quartz, hornblende, mica, and magnetic iron; at the surface they are soft, but lower down the beds assume considerable hardness.

Those strata are of great thickness; they form the whole of the northern slope of the range, and the three spurs described as joining the starting point of the range, belong entirely to this formation, save that in the Rhotás spur the Devonian strata appear. Beyond Jalálpúr, on the south slope of the range, no miocene strata appear at all during the whole series till we cross the Indus and come to the Chichalli hills.

It is not certain whether the strata are of marine or fresh water origin, but there are no marine remains any more than there are in the Thibet tertiaries. The hills between Rawalpindi and Baramulla pass, are referred by DR. FLEMING to this series; indeed, from the Baramulla pass to Uri on the Kashmir river, nothing but miocene strata occur, forming ranges often to 8,000 feet in height.

Gold in minute scales occurs in the formation, which has been described in its proper place.

In the sandstones and grits, bones and teeth occur, remains of large mammalia, generally fragmentary, and rubbed, as if transported from a distance. Portions of teeth of *Mastodon*, *Mammoth*, *Elephant*, horns of deer, and teeth of a species like the camel; some large Saurian teeth, and the Carapace of a Chelonian was found: the fossils are nowhere in great abundance. There is also much fossil wood silicified and of a brown color. Of molluscs, only species of *Unio* or *Anadonta* were found by DR. FLEMING.

It appears highly probable that these latter beds are the western extension of the Siwalik strata.

Above the tertiary strata are alluvial deposits of quite a recent formation; they are full of boulders and form beds of gravel. There are also belts of kan-kar and calcareous concrete. Over the surface of the nummulitic beds and miocene strata, travertin and calcareous tuffa have been formed, which are very valuable as sources of lime.

As to the general deposition of the hills, it would appear that the Devonian salt marl strata, judging from the ripple mark, were deposited in shallow water; that the lower carboniferous beds, judging from the Brachiopoda remains, were deposited in deep water. From this it is inferred that the Devonian strata first were sunk sufficiently low to admit of this deep water deposit on their surface; the carboniferous strata then must have rapidly increased in thickness, since the upper beds contain shallow water Cephalopoda. The sandstones of the middle carboniferous appear to be deposits of the surface of this sea, as marks of rain are seen in some of the beds; then it appears that the whole must have sunk again to a sufficient depth to allow another sea to form above them, full of the deep water Brachiopoda, which occur in the upper beds of the carboniferous series. Again these beds must have accumulated to the surface, for the colitic grits and shales contains ferns and remains of coniferous land produce. Again a subsidence appears to have followed, during which time the strata, now containing *Ammonites*, *Belemnites*, &c., were deposited; and the strata probable did not re-emerge till the close of the nummulitic formation. By a gradual and local deposition of calcareous matter along a particular line, similar to the manner in which coral reefs are formed, a sea barrier may have been raised inside which, in an inland fresh water sea, the miocene strata have probably been deposited."

When these strata were thus deposited, the beds rising and sinking at various period all the while, a grand upheaval of the whole appears to have formed the hills and valleys of the now Salt range, and to have completed the formation. It is impossible to notice the strata curved, broken, and displaced as they are in many places, and the complete submersion of strata at Kalábágh, and in the Chichallirange, without coming to the conclusion that the strata have been subject to violent upheaval; the burnt appearance of some of the lower marl strata, and the calcination of the included gypsum has been mentioned already, but there is nowhere any indication of an effusion of trap, or volcanic rock.

The foregoing is a geological sketch rather than a sketch of mineral products in an economic point of view. The various products that are valuable have

been noticed along with the name of the specimen, but it is not easy to let the subject pass without a reflection on the extensive mineral wealth of the range; not only are building stones and marbles of great beauty produced in abundance, but we have a large variety of stones supplying lime to any amount; there is also gypsum for plaster of Paris, and various red earths and ochres occur, having value as coloring agents. Salt, coal, sulphur, petroleum, are all found; and many metals—copper, gold, lead, and iron; the latter as rich hematite, very abundant in some parts, to such an extent that the rocks containing it, prevent, by their attraction, the indications of the magnetic compass.

The Sulaimán Range.—It is unfortunate that our knowledge of the Sulaimán range is very confined. The wild and lawless habits of the tribes inhabiting them have hitherto prevented anything like a geological survey; little is known beyond what can be observed at the foot of the ranges bordering on our own territory, or inferred from considerations of similarity of structure with known ranges.

The upper portion of the Sulaimán range is unrepresented in the collection. The range forms the boundary of our territory on the west, and the length of the range is a little over 350 miles; of its geological structure there is not much known. Vigne states that, "it consists of recent formations, principally sandstones and secondary limestone," that the fossiliferous portions contain ammonites and marine remains. "The strata," he adds, "are much shattered and contorted, and often overlaid by shingle or débris." The loftiest peak in it is the Takht-i-Sulaimán, "Solomon's throne:" 11,000 feet. The Derájat division is watered by the streams which descend from this range.

The range itself is remarkably productive of vegetation and trees. The minerals representing it are from the districts of Dera Gházi Khán and Dera Ismail Khán.

The Dera Ismail collection includes iron ore, coal, and native mineral sulphur from the Sulaimán hills; also some limestones, clays, and red earths from the lower portions of the Wazíri country.

The Dera Gházi Khán mineral collection represents the portions of the range joining the Lagázi, Mazázi, and Gyandári hills, and the lower hills subordinate to the rest of the range. The minerals are coal, limestone, several clays, and red ochres, and a genuine fuller's earth; a sample of antimony ore is sent also, and alum shale, found in the Gyandári hills.

There are fossiliferous strata of the Lagázi hills, a few fossils from which are sent. The Mazázi hills indicate their formation by the nummulites that are sent from these localities.

The Wazíri hills are represented in the Bunnoo

collection, they exhibit much the same geological features. Sandstone appears from the Shaikh Budin hills, and iron from the hills south-east of Bunnoo; the hills of the Khost valley beyond the frontier produce asbestos.

It is from this remarkable group of low hills in that corner, as it may be called, where the Salt range meets the Sulaimán range, that the best collection of fossils in the Exhibition came.

The Balút range is represented by fossil shells of genera—*Productus*, *Athyris*, *Orthis*, *Rhynchonella*, *Streptorhynchus*, *Lima*, *Natica*; together with *Anomia Lawrenceana*, *Spirifer*, *Pecten*.

There are also series of the limestones of this range and several shell limestones and coralline limestone, with species of *Cerriopora* and *Lithostrotion irregulare*; and from Shaikh Budin there are *Belemnites*, *Cidaris*, *Pecten*, and other species of *Rhynchonella*, *Terebratula*, *Lima*, &c.

The sandhills to the east of Shaikh Budin, abound in mammalian remains. There are bones and teeth of mammoths, and species of elephants and hippopotamus, several horns, tusks and teeth of herbivorous animals and rodents; and there is also a large fossil tree of monocotyledonous structure.

ON THE OTHER SIDE of the Punjab territory, there remain yet to be noticed that series of low hills, from which is derived the mineral wealth of Delhi, Gurgaon, and Hissar; they appear to be spurs and offshoots of the extremity of the Aravalli range. The principal hills are the Delhi hills, in the south-west of the district of the same name, and the Shekhawati hills, in Gurgaon, &c., and the Kalyána hill, at Dádri, which yields the flexible sandstone, and a gray marble, called Narnaul marble. It is among the hills in the Delhi district that the crystal series of Aurangpúr occur, and that a white clay supposed to be kaolin is produced. The range of Delhi appears to contain limestones—marble, and some sandstone strata—the sandstones are probably Vindhyan. In Gurgaon several clays—white, red and yellow—and mica occur; also hematite and ironstone, and also copper, both at Singhána and in Hissar. Ballabgarh yields white and red sandstones, and the mottled, red, and white, and blackish of the "new red" group.

The most marked hill ranges in the Gurgaon district appear to be first, the hills that rise on the boundaries of the district, in the extreme south of the Firozpúr Iláka; these hills run almost due north, forming the west boundary of the Gurgaon district as far as the villages Firozpúr or Noh. On reaching the confines of Noh the range turns off to the north-east, towards Sonah close to which town it passes. At some considerable distance beyond Sonah, it spreads out into three spurs, the eastern one running to Bhánsi;

the middle one along this spur, runs out into the Jharsah Iláka, on which are many scattered hills besides; and the third, or western spur, continues within in the Sonah Iláka, and ends a little beyond Kásun. The length of the greater range must be about 50 miles.

There is also a range of hilly tracts on the south, which rises in the Firozpúr Iláka, like the range just described, but on the other side of the Iláka, it at first runs parallel to the first range but after some-time branches off to the east, and ends in the Hatin Iláka; the length of this range must be about 25 miles: it has some off-lying hills, particularly on the east side.

There is also an outlying hilly tract on the north, in the centre of which would be point of junction of the boundaries of the Sonah, Pakal and Jharsah Ilákas, but the principal part of it is within the Pálí and Sonah Ilákas. The latter hilly tract expands beyond the Gurgaon district, forming the hilly tract on the north-west corner of Ballabgarh, from which place an offshoot in a north-westerly direction for some distance past Mahrooli and the Kuttab Minár; it then suddenly divides into two arms, one of which runs due south back again towards Jharsah of Gurgaon, and the other due north-east to near the city of Delhi. These are the only hills in the Delhi districts, the north-west portion contains no high tracts. On the Meerut side of the Jumna a long range of low hills runs along the banks of the Jumna, but that is beyond the boundaries of the territory with which we are concerned.

The hills must certainly be considered as the marked feature in the Gurgaon district. One range, from a glance at the map, will be perceived to traverse nearly its whole breadth during part of its course, passing through the pergunahs of Jharsah and Sonah, and for the remaining part forming the boundary to the west between the pergunahs of Noh and Firozpúr and the territories of Alwar. A second rises near Peningwa of Pánahana, and running south forms to the east the boundaries between the pergunah of Firozpúr and the territory of Bhurtpúr. These ranges, and the country in their vicinity, are possessed by the Meos, and popularly called the "Mewat hills," and to the nature of the country in which their fortune had thrown them may not improbably be traced the origin of the predatory habits which have been considered to distinguish this tribe. Again to the north we fall in with a shorter and smaller range of hills than those I have alluded to, dividing the pergunah of Pálí from those of Sonah and Jharsah, and terminating at Delhi on the Jumna. These hills and the country in their vicinity are principally occupied by the Gújars, a people similar in habit to the



Meos, and certainly at this date exhibiting far smaller signs of improvement.

"There are no other ranges of hills within this district. Detached hills are common, particularly in the pergunah of Rewari, but none of considerable size or continuance. Here too, however, the country in the vicinity of those hills will generally be found to be occupied by Ranghurs, the worst tribe known in this territory.

"All these hills, whether the ranges or the detached portions are of insignificant height. I doubt whether any in the district will be found of an elevation of 500 feet above the level of the country at their base, and they yield nothing. The grazing on them, as far as I have had an opportunity of observing, would seem insufficient to support a few goats. There is no wood produced on any portion of them, and even the very stone of which they are occasionally composed, appears a useless material, either a quarry impossible to work or a sandstone possessing no durability.

"It may be marked that the western range of hills, which I have noticed, would seem rather to be the termination of the great table land of Rajputana, than any rising which can with precision be termed a hill or range of hills. At Sonah, mount the hill beyond

that town, and you find yourself at once on the plains of Rajputana. In this view this range is to be distinguished from those of Pali and Peningwa, the country on either side of which is pretty, and of the same level.

"I have not a sufficient acquaintance with geology to hazard a conjecture as to the formation of these hills. Certainly, however, in so far as a person unequal to form a scientific opinion may be justified in giving one at all, these hills (in Rewari particularly) appear most of them to exhibit signs of volcanic origin, and even now, as I have heard stated on what seems to be good authority, symptoms are occasionally perceived which would seem to show an agency of the kind to be still at work."*

The geology of these hills, is as yet unstudied. Scattered notices of these are to be found in various papers. The "Gleaner in Science," vol. ii., 143, has a notice on the Geology of the Bhurtpur district; and in the 3rd vol. of the same work, is a brief account of the ironworks of Firozpur.

In the Asiatic Society's Journal, vi., 53, is also a notice of the geology near Delhi.

* Report on Delhi and Gurgaon, p. 5-7.

SUB-CLASS (C). SOILS.

It remains now to add to our brief survey of the hill regions of the Punjab, some account of the nature of the soil in the plains. Of the hill districts, we are in possession of information varying in amount and value, according as they have been surveyed or not. The hills of the Delhi, Gurgaon and Hissar districts, including the Mewatti hills, are hardly known or described at all; although from the Exhibition collection, it is evident that their metallic and other products are as valuable as they are interesting, including iron, copper, plumbago, sulphur, marble, mica, rock crystal, kaolin, slate, and many others. On the other side of the province, the Sulaimání hills are unknown, save from what can be observed on the lower slopes bordering on our own territory, and what is inferred from a knowledge of the relation in which these ranges stand to other ranges, which we have been able to examine. The same may be said of all the network of hills north of the Salt range and Peshawur, Yusafzai, including the Wazíri hills and others, as far as the "Safaid Koh." Nor is it easy to extend our information till persons with the requisite geological knowledge are brought to the task. The officers of a district, however intelligent and willing, are generally unable to carry out surveys of this description; they will moreover be so constantly liable to error in describing the rocks and strata, and in referring them to any probable era of formation, as to render their observations necessarily of little value. This was to a great extent visible in the mineral collection of the late Exhibition, where a want of mineralogical and geological knowledge has caused limestones to be called sandstones, gypsum to be called soapstone, iron pyrites to be mistaken for gold ore, and has given rise to many other mistakes, which rendered the preparation of a correct Catalogue hopeless; save in the way in which it was actually effected, by going through the whole collection, and ascertaining, proximately at any rate, the nature of the specimens (by whatever name called), from the results yielded by the ordinary chemical tests, and by the blowpipe. In this way many a bright vision has been dispelled: the promised tin ore of Hazara proved to contain no trace of tin; the Lahore samples of a supposed native sulphide of zinc, yielded no indication of that metal; and several supposed copper ores and auriferous sands failed in a similar manner to evince any intention of producing the desired metals. Hence our knowledge of our geology is not likely to increase till we have scientific surveys of these hills; but considering the amount of mineral wealth that even an unscientific examination proves them to contain, it would be well worth while to examine them carefully. The hills of Gurgaon and Delhi would well repay a scientific survey, like that given the Salt range, by **DRS. FLEMING and JAMESON.**

Our sketch, therefore, of these hill regions was necessarily very imperfect, and serves rather as an indication of paths to be pursued and investigations to be conducted, than as a summary of results already obtained, or of facts known and recorded.

The consideration of the structure of the great plains of the Punjab is not beset with any such difficulties; the mineral products of the plains are few and their characteristics easy of recognition. The differences of the soil are determined by a chemical analysis,



and the main distinctions observable are the results of simple causes, to be described as we proceed. These attract the notice of the cultivators of the soil, who attach names to the varieties of land that occur, and which strike their attention as being more or less productive, as yielding to advantage only certain kinds of crops, as being sandy and barren, as requiring large irrigation, and the like. We shall of necessity resume the subject when we come to the Agricultural Section of the Exhibition, and many descriptive notices of the "bar" country,—of the desert tracks, and river-side plains which are omitted here, (as illustrating rather the cultivation than the geology of the localities,) will be found under that class.

The plains of the Punjab may be described as vast expanses of alluvial clay and loam, whose elementary constituents must once have been the same as now form the rocks of the huge ranges of mountains to the north. The principal constituent that produces a variety in the nature of soils, and one which is very important in the Punjab, is sand; in fact the main distinction of soils (apart, from that of their containing or not containing "kair"—the efflorescent salt), is that the soil is sandy, as in many portions of districts it is, or that it is rich loam and clay. The sand is either washed down by rivers which flood their banks,* or else the streams change their course, leaving beds of sand behind, as is often the case in the Punjab; in some cases also sand is blown by winds from adjacent sandy or desert regions, or from these very deserted river courses, to districts where otherwise it would not be found. The influence of sand in the district of Hushyárpúr may be taken as an illustrative example. In this district the hills, being of sand formation, are constantly contributing to silt up the shallow beds of the torrents until the water overflows them, and finds a lower level. The sand is then drifted by the high winds that frequently prevail over the surface of the country, until, in course of ages, the tract for some distance from the hills, has obtained a high level, and to this is attributable the fact of the non-existence of kankar for metalling roads.

At Adampúr, and 20 miles from the foot of the hills, kankar is found on the surface: whereas it is found at Hushyárpúr only at the bottom of the wells, some 15 to 20 feet below the surface, after digging through sand, and sometimes deposits of loam and clay.

The alluvial plains thus constituted are intersected at intervals by the rivers of the Punjab. Every tract of country between two rivers forms a "doab," a tract which is always higher and more sterile towards the centre, and gradually becomes more fertile on either side, as the river is approached. The rivers usually overflow their banks sometimes to the extent of miles round during the seasons of heavy rain, and contract in the dry seasons till the slender stream is spanned by a bridge of a few boats, having dry beds of sand or mud on either side, which are then brought under cultivation. Such being the character of the rivers, changes of their course of greater or less extent are not unfrequent.

To take one instance, the Rávi at Lahore, which once flowed close to where the Múltán

* Some rivers are much more liable to be flooded to excess than others. The Markanda, in the Ambálla district, is a remarkable instance out of many; at one time of the year it is like an ocean; at another it will be a slender stream, hardly to be called a river. The Indus always contains a large body of water, but even this river is liable to become dammed up in the hills, whence it rises; the water then accumulates and bursting at length these bunds, come down with terrible force; once or twice these floods have occurred, giving only a few moments notice by a sound as of distant thunder, and then coming on with a sweep that spreads desolation for many miles. The rise of the Rávi, Chenáb, and other rivers, will be familiar to every one who has travelled in the Punjab.

The reader of Punjab experience, will remember how at some seasons he has crossed a river on a bridge of boats not a hundred yards long; while at others, he has scarcely been rowed across the same river in six hours, the water having risen and extended to the size of a small ocean. This rise will frequently take place in the course of a couple of days, sometimes in a few hours.

road runs (it carried away a portion of a beautiful ruin standing at the side of it), and then flowing on, passed close under the walls of Lahore,—has now so altered its course, that it cannot be seen even in the distance from the Múltán road, and it runs also nearly two miles distant from the city. Besides the rivers, the country is also fertilized by “nallahs,” or water-courses, running into the country from the river beds. These are formed during the overflow of the main rivers; the water forces for itself a passage inland and accumulates in some place where the soil is soft, or some other peculiarity of the ground renders the excavation easy, and thus having once made a deep groove or channel, it remains there afterwards, drying up at the end farthest from the parent river, during the continuance of the hot season. Some of these nallahs, contain a very considerable body of water, and traverse whole districts; of this fact the Deg nallah, in the Lahore district, furnishes a good example.

In color the soils are generally of a drab or pale brown-gray; in some places they are darker from the presence of organic matter, and in the very poor and “rukḥ” lands soils are pale, whitish, or yellowish-gray. Sometimes these soils are reddened slightly by peroxide of iron.

The soil is mainly classified firstly, according to the presence or absence of river, nallah, or canal irrigation; being called “bárání” when dependent solely on rain; “chāhi” when irrigated by wells; “ābi” when irrigated by canals or nallahs; “sailābi” when its productiveness is dependent on periodical flood or overflow of water in the neighbourhood, (“sailab,”) or when the land is of such a nature as to be under water, from the mere fall of rain in the wet season. The second classification is according to the nature of the soil, whether stiff clay, sandy loam, or full of sand; but the terms descriptive of these peculiarities also to a certain extent include the consideration of moisture also.

The following is a brief account of the principal varieties of soil, but the names vary in several districts; and others have peculiar names for varieties which are not recognized beyond the boundaries of the districts in which they occur.

The varieties of soil mentioned, depend on differences which indicate the degree of productiveness and the necessity for artificial irrigation, more than any real geological difference in composition of the soil, and hence a minute consideration of them, more properly belongs to the agricultural section.

I will take as a standard, an ordinary plain district, exhibiting a fair amount of alternation of stiff clayey, pure alluvial, mixed sandy loam and barren sandy tracts, as also a fair amount of variety of irrigation—river, nallah, well or rain—and after noticing the kinds of soils we find there, I will add a notice of such soils as are recognised in other districts of similar character, but different geographical position.

Let us take for instance the Gujranwallā district. The great sub-division of land, is into high and low land, called “ūtār” and “nētar,” the high lands being out of the reach of rivers, &c.; the “nētar” lands being on the banks, or otherwise subject to their influence. The “nētar” lands are sub-divided into “bet” and “dhaya,” that is sailāba land, subject to periodical inundation from the river, and land not so subject, respectively.

The “netar” has a number of varieties, called bhāngar, mera, des, rohi, &c.

Rohi is the finest natural soil, a stiff loam, which breaks up into large clods.

Doshāhi is the “dumat” of Hindústān; a clayey soil, generally of good quality, manured by cattle being folded on it; when manured, it grows cotton, fine wheat, barley, joar, makai, melons, &c. Without manure produces the ordinary crops of barley, goji, and pulses. It is common all over the district.

Mera, a mixture of clay and sand, the “rusli” of Hindústān, has many varieties; some very good and equal to the best “doshāhi.”

Tibbāh, nearly all sand, the “bhār” of the provinces, worth very little, and only grows the inferior crops of moth, māsḥ, &c.

Besides these there is a class of land which receives irrigation from the drainage of the higher “bar” and other lands, this is called “chamb.” In this class, a good rice producing land is often found, and is then called “chamb rohi.”

New land on the river bank often covered with fine

alluvial soil, is called "bela."* Land that is highly manured being irrigated land, in the vicinity of villages, is called "goera," and in the Cis and Trans-Sutlej States "nyái."

High and somewhat sandy tracts in the centres of "doabs," and equidistant from river influence on both sides, are called "bár," almost universally.

These names will be found to exist very generally in the Upper States, or Punjab proper; the names *baráni*, &c., indicative of *irrigation*, are quite universal.

In the Cis-Sutlej States, the main divisions of the soil, to a certain extent corresponding to the *nétar* and *útar*, are the low lands, being called "*khádar*;" lands which have at one time been the beds of rivers, or have been flooded; and "*bángar*," high land, requiring irrigation by wells. These great divisions are sub-divided as "*nyái*," loamy land, cultivated with manure and artificial irrigation; "*rúslí*," good loam; "*dákar*," a low lying stiff clay, productive of rice and gram; and "*bhúr*," an inferior land with a large proportion of sand. Land that is inundated is generally unproductive for want of drainage, is called "*choil*." As we approach Hindústán, the Hindústáni names become more common, and the Punjabi ones less so. In some of the sandy districts, as might be expected, the names vary considerably. In the Gngaira district, for instance, where the soil is very bare, there is but little scope for all the varieties of inundated, irrigated, and other lands; if land is culturable at all it is fortunate, and there is but little variety to distinguish. The most generally recognised names of the descriptions of culturable soil are "*gusrah*," "*sikand*" and *retlí*." In the Settlement Records, the name "*dákar*," which is locally unknown, was introduced by the Hindústáni ameens employed on the measurements. The equivalent term is "*gusrah*." "*Retlí*," as its name implies, is land with an excess of sand, and "*sikand*" is a stiff clay soil, suited for rice; it is called in some parts "*pakki chikni*."

In those parts of the country where regular sandy tracts occur, such as Shahpúr, Jhung, Muzaffargarh, these tracts are called "*thal*," or desert.

Some districts do not appear to recognize any classification at all. In the Jhung district, the people, with the Settlement Officer, the late MR. MONCKTON, could only say that their land was full of sand, or their crops destroyed by "*kalr*;"† at present it appears that the distinction of *nahri* (canal watered) and *baráni* (rain watered) is adopted.

The mineral products of such alluvial plains are few in number.

The first to be mentioned is the "*kalr*," a salt efflorescence, which is observed in many places.* Sometimes it extends over large tracts of land, rendering them almost entirely unproductive; they are called "*kalri zamin*."

Some kinds of plants like the *kalr* soil, among these may be mentioned garden stocks and wall flowers, and other brassicaceous plants; and also tobacco is said to thrive.

The water of wells in such districts is always bad; it contains so much sulphate sometimes, as to be almost brackish to the taste. It also contains (as does all the well water of the plains examined) carbonate of soda, a circumstance which may serve to account for the production of the *kalr*. These waters, if left standing for a day or two become highly offensive to the smell and taste. DR. BROWN, the Chemical Examiner for the Punjab, has exhibited a nitrate of lime as a remedy for *kalr* lands, which would convert the sulphate into a nitrate, by mutual decomposition. An account of this nitrate of lime will be found subjoined to the notice of the exhibited specimen.

The *kalr* salt is not made use of save at Kálábágh under the name of *jámsan*, in the manufacture of alum; the use has already been described. Should however the *kalr* consist of *carbonate*; then, indeed, the soil is used by "*dhobis*" for washing, and is also melted into a crude glass.

The next product is *kankar*. This is a calcareous concrete, consisting of carbonate of lime in irregular kind of foliated pieces; it occurs in almost every district and is dug out of the soil; it is extensively employed as a road metalling material, from its great power of binding; some kinds of it are also burned and yield lime. The formation of *kankar* may be supposed to be constantly going on; that found at the surface of the soil is small and friable, but that dug out from below, after washing and shaking in a sieve to free it from adhering mud, is a hard serviceable material. Contractors and others hire land from the cultivators for a fixed period; they dig the *kankar*, and when they have exhausted the store, they level the land which is then cultivated once more: the same land will again yield *kankar* after a certain interval.

It was mentioned just now that many of the Punjab well waters contained carbonate of soda, hence it is possible that water containing carbonate of lime may percolate the alluvial soils, which contain of necessity sulphate of lime, so that the action of the carbonate

* Settlement Report Gujranwalla District.

† Jhung Settlement Report, p. 21.

* Of the effects of this, an account will be found in the notice which follows this section.



of soda and sulphate of lime on one another, results in the formation of kankar (carbonate of lime) while the sulphuric acid has attached itself to the soda, forming the efflorescence of sulphate of soda.

The last product to be mentioned is saltpetre, (nitrate of potash) which is found in several soils, and especially near old buildings, where it effloresces freely; the process of its manufacture has been described.

Sal ammoniac has also been noticed as produced in brick kilns.

Of the varieties of soil in the hills we have less information.

Taking the hill districts bordering on the Ambálla division as an example, we find in Kotaha in the Ambálla district* the land divided into "kuláhú," land watered by kúls (water-courses supplied from an artificial pond formed by damming up the hill streams), and "obár," which is the same as bárání, land dependent on rain for its irrigation.

Obar land is of two kinds, "todah" and "khíl." Toda are those little hanging fields like steps rising one above another, and are built up at their lower edge with stones, and which are liable to destruction by being washed down when the rain is violent. If the land is good, it is called "awal kism;" if stony and bad, "dáyam kism." "Khíl" land is that which is broken up with the hoe on the steep slopes of the

hills; it is too steep to be ploughed. These kinds of soil are observable through many hill districts.

In the Kangra valley, we meet (as might be expected) with new names; the locality is singular, as to its climate, soil, and means of irrigation.

The usual distinction is as to whether the land yields one or two harvests in the year, *i. e.*, "ek fasli" or "do fasli." The soil consists essentially of disintegrated primary rocks, with a sub-soil of boulders, affording good drainage;* the principal varieties are dependent on the nature of the adjacent formation; one kind being sandy and light, near the marls of secondary formation; and the other, a reddish soil full of gravel stones, being the tertiary formation. The names of soils are:—"bílochí," which is the best soil. "Delanoor behauli," gives wheat and rice alternately; unirrigated land is called "utar," and irrigated land, "kalesi"—"har" and "basand" lands yield only one crop.

In Peshawur it should appear that the unirrigated land is termed "merah," and villages at the foot of the hills whose soil is watered by springs, are called "koh-i-dáman."

I now conclude this sketch of the soils of the Punjab with an analysis of soils from several localities. The specimens from which these analyses were made, are in the East Indian Museum of London; the analyses are on the authority of DR. FORBES WATSON.

* Wynyard's Report, p. 30.

* Kangra Settlement Report, p. 53.

Territory.	Locality.	Remarks.	Composition per cent.												
			Water at 212° F.	Water above 212°, or organic matter.	Silica, free or combined.	Alumina.	Peroxide of iron.	Carbonate of lime.	Suphate of lime.	Lime in other forms.	Magnesia.	Potash.	Sodium as Chloride.	Soda in other forms.	Phosphoric acid.
PUNJAB.	Near Rawalpindi, Sind Sagur Doab,	Drab colored dense soil, ordinarily cultivated,	4.430	2.840	59.500	17.890	5.110	1.164	0.069	6.778	0.720	1.038	0.074	0.404	0.107
	Numbhal, Sind Sagur Doab,	{ Reddish drab distinctly calcareous, cultivated but not manured, }	3.940	1.010	50.490	11.890	7.420	16.660	0.839	3.915	1.218	1.102	0.315	0.943	0.069
	Kot Isa Shah, in the Jach Doab, between the Jhilam and Chenab,	{ Cultivated, but not manured, }	1.750	2.410	66.640	12.620	6.310	9.810	trace	...	1.330	0.520	trace	0.213	0.043
	Lahore, between the Ravi and Sutlej,	{ A light drab colored impalpable soil, carefully irrigated and cultivated with rice, the best soil near Lahore, }	3.930	0.930	63.800	12.660	10.000	4.000	0.041	1.033	1.910	1.029	0.036	0.722	0.132
	Ditto, ditto,	{ Light drab colored sub-soil, 5 feet below the surface of a rice field, yielding the last mentioned soil, }	2.160	0.500	66.337	14.630	4.100	5.459	0.051	1.590	2.010	1.820	0.033	1.313	0.097
	Ditto, ditto,	{ Light drab colored sub-soil, 10 feet below the surface. Very good siliceous soil, }	1.260	3.700	65.800	12.814	6.280	4.690	0.155	...	3.070	1.244	0.080	0.900	0.092
	Sirdarpur in the Bari Doab, between the Ravi and Sutlej,	{ Cultivated soil, }	3.930	0.930	63.800	12.660	10.000	4.000	0.041	1.033	1.910	1.029	0.036	0.722	0.132
	Multan, Bari Doab,	Light drab sub-soil : 3 feet below surface,	1.090	1.370	68.670	14.150	6.340	3.182	0.090	0.661	0.590	2.130	0.073	1.232	0.109
	Naushera, in Bahawalpur,	{ Stone colored calcareous sub-soil, 2 feet 9 inches below the surface, }	2.120	4.080	57.900	15.000	3.500	9.620	0.452	3.130	2.300	0.830	0.262	1.000	0.140

Class I. Division V. Sub-Class (C).

NOTE ON THE SALINE EFFLORESCENCE ON CERTAIN SOILS, KNOWN AS "REH."

I.—Origin and formation of Reh.

The subject of the deterioration of land by the efflorescence of "Reh" or "Kahr" has formed the subject of a Pamphlet, No. XLII, of the Records of the Government of India, in the P. W. Department. As the original may not be easily accessible to many readers, I purpose to present a sketch of the correspondence which has passed on the subject, as well as to describe those practical conclusions which are to be drawn therefrom.

The deterioration of land was first observed, or at all events first attracted serious attention in the villages along the Western Jumna Canal, and its branches, about Delhi, Paniput, Rohtak, and Karnal. In 1857, MR. SHERER, Joint Magistrate of Allypore, went on deputation to examine the tracts of country deteriorated, and the picture presented by him of the suffering in some of the villages was truly deplorable. Out of 580 canal villages, 59 or nearly 10 per cent., had been injured in degrees ranging from severely to partially, 6 per cent. being severely injured. The maximum appeared to be reached in Paniput where 46 villages, or 19 per cent. were injured out of 242. COL. BAIRD SMITH estimated the loss of Revenue for the villages spoken of in MR. SHERER'S Report (which does not include the Punjab proper) as Rs 25,000 per annum. The water of the canal was submitted to SIR W. B. O'SHAUGHNESSY, who on analysis, found it to contain nothing prejudicial to growth of crops, nor was there anything in the sub-soil itself. COL. BAIRD SMITH demonstrated that the evil arose from the fact that the canal was embanked, and high above the level of the country: the consequence was that the water percolating through the soil on either side of the canal, in obedience to the law of fluids, rose upwards to seek its own level: in so doing it passed through the sub-soil, formed the salt (which he conceived to be in the soil itself) and worked its way up to the surface; there the water evaporated and left the salt in the form of a white powdery efflorescence. COL. BAIRD SMITH considered that this would go on as long as the action of the water continued; and recommended as the only permanent remedy, the re-alignment of a large portion of the

canal, bringing it at a proper level along the natural watershed of the country. Heavy rains and drainage only effected a partial remedy for the evil. COL. SMITH argued strongly that although the costs of the change of canal line would be great, yet it would save the immense loss entailed on the revenue by the destruction of cultivation.

It must not be supposed, however, that the injuries arising from Reh occur only in land near the Western Jumna Canal. The salt effloresces in several parts of the Punjab, where there are no canals at all; in these places it appears in land irrigated from wells where the water is very far from the surface. In all cases the salt appears as soon as the soil dries. It is previously held in solution, and on the water evaporating, forms a white powdery efflorescence on the surface. It is a peculiarity of all efflorescing salts that they rise to the surface: the reader will see an instance of a similar efflorescence in the account of the production of Borax from the Puga valley in Ladakh.

The views that have been entertained as to the formation of Reh are various; some have positively denied that there is anything in the canal water, and insist that the Reh exists ready in the soil, and is dissolved and brought up by the percolation of moisture. Others have held that although the salt does not exist *as such* in the soil, yet there may be minerals in the soil, which acted on by water, more or less charged with carbonic acid, decompose and result in the salts and in kankar, &c. Others again consider that the small amount of salts proved to exist in the canal water, may by gradual concentration form a dangerous amount of salt in the soil. Both the latter views are probably more or less correct. The ablest exponent of them has been MR. MEDLICOTT, Professor of Geology at Roorkee. MR. MEDLICOTT observes that from DR. O'SHAUGHNESSY'S analysis, the water of the canal is generally pure: one sample however is noted as containing " $\frac{1}{1000}$ " of solid matter, partly organic, partly saline; the salts being lime and soda." The sub-soil at 2 feet below is clear of salt, and the efflorescence is only at the surface.

MR. MEDLICOTT remarks, however, that a decimal per centage of saline matter in the water may by

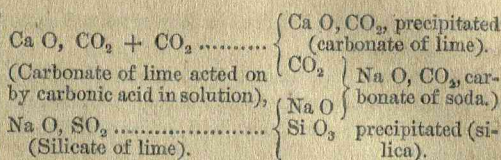
evaporation, soon accumulate to 3 or 4 per cent. The great majority of places affected by Reh are low lands, which receive the drainage of the surrounding country or are subject to swamping from the canals having no sufficient drainage. The water is therefore not disposed of otherwise than by evaporation. In this way minute portions of salt accumulate and gradually form, in the course of years, a superficial product destructive to cultivation. The rate of evaporation is of course very high, and such lands as Reh most often appears in, besides the direct effects of irrigation with water containing a fixed decimal proportion of salt, also receive water running from other lands which may contain a great deal of salt.

"The evident facts of the case go to prove that the injurious accumulation of salt is the slow result of prolonged concentration, of which the essential concomitant is swamping."

"It is a direct inference that if swamping is prevented and the drainage provided for, Reh will not appear."

MR. MEDLICOTT considers that this formation by concentration of infinitesimal quantities is the chief source of Reh; but admits that in some places the Reh seems due to a "supply of the salts more or less concentrated at some depth below the surface, from which the Reh is derived by the change produced by the water in circulation near the surface."

Whatever truth there may be in these arguments, it is quite certain that gradual concentration of saline matters in the water cannot be the only source of Reh, since all over the Punjab, Reh may be found in fields watered only by wells, on high banks and uplands, and on desert tracks, which have no water whatever but rain. DR. ANDERSON, of Glasgow, expresses his opinion (which is perhaps the most reasonable as well as the one most commonly received), that the *constituents* of the Reh itself exist in the soil, and that when water acts on these, a catalytic action is set up, resulting in the formation of the Reh salt. DR. BROWN, Chemical Examiner, follows this opinion, and is opposed to the concentration theory,—at any rate as a generally or frequently applicable one. Whether the formation of kankar (the concrete of carbonate lime) has anything to do with the formation of Reh, is not yet absolutely determined; though from the frequent observations of beds of kankar underlying Reh lands, it is more than probable that kankar is one of the products which form in the process. Several observers in Oudh have put forth these views, though some deny it. DR. WHISHAW, of Faizabad, has expressed the probable action by a series of formulae: it is to be observed that in the Reh observed by him, *carbonate* of soda, and not the sulphate, predominated: it would be easy by substitution to construct a formula for sulphate of soda.



That the salts are formed by the action of water is certain: *perfectly* arid soil would not produce the "Reh." When the formation is complete, the salts are either dissolved by rain or melted in their water of crystallization by the sun's heat (which they are at 98°); and then on any reduction of temperature re-crystallization, in a network of small crystals through the pores of the soil ensues. By capillary attraction the crystallizing salts creep upwards to the surface, and there giving off their moisture, fall in a white powder. It is the capillary attraction that accounts for the efflorescence being so often seen up the sides of high banks: just in the same way, if a solution of salt is left to dry up of itself in a basin, the saline deposit seems to creep up the sides of the vessel.

It will be necessary in order to arrive at a definite conclusion as to the formation of Reh, to examine more carefully the circumstances under which it appears. In Oudh (where the soil is called *Oosar*), several officers report that kankar is always found underlying Reh, others saying it is not; but the observations in Oudh have not been yet exhaustive, and the subject can only be determined after a series of accurate scientific observations, and not only on general official reports.

II. Analysis of Reh: the uses of the Salt.

With regard to the chemistry of the subject, I may remark that the canal water, well water and soils affected, have been submitted to analysis by MR. MEDLICOTT, Professor of Geology at the Thomason College, and by DR. BROWN, Chemical Examiner of the Panjab.

In the first place as to the salt itself. It consists of sulphate of soda with a variable proportion of chloride of sodium (common salt). MR. MEDLICOTT, found in a sample from soil near the Western Jumna Canal, 76 per cent. sulphate of soda and 24 per cent. chloride of sodium: another sample gave 96 per cent. sulphate to 4 per cent. chloride. DR. O'SHAUGHNESSY gives a case in which the prevailing salt is carbonate of soda. Soils containing from 5 to 8 per cent. of the Reh appear to be unfit for cultivation.

In some of the instances given by DR. O'SHAUGHNESSY, the per centage is much higher; at Jagú, in Paniput, it was 20 per cent. and this consisted of abundance of carbonate of soda with sulphate, and chloride of sodium and lime. At Fálá, of Paniput, the

per centage is 22.80; but there is little or no carbonate or nitrate of soda.

DR. THOMAS ANDERSON, Professor of Chemistry at Glasgow, analyzed in 1863, a sample of Reh from the Western Jumna Canal lands; its constituents were as follows:—

Soluble in Water.	Water, - - - -	7.40
	Organic matter, - - - -	6.61
	Alumina, - - - -	2.52
	Oxide of Iron, - - - -	trace.
	Lime, - - - -	1.09
	Magnesia, - - - -	0.51
	Potash, - - - -	1.84
	Soda, - - - -	1.44
	Chloride of sodium, - - - -	10.41
	Sulphuric acid, - - - -	6.06
Soluble in Acids.	Peroxide of iron, - - - -	3.30
	Alumina, - - - -	1.95
	Lime, - - - -	1.84
	Magnesia, - - - -	0.98
	Phosphoric acid, - - - -	trace.
	Silica, - - - -	54.46
		100.41

The insoluble parts are the constituents of the soil itself, a portion of which was mixed with the efflorescence collected.

The specimens of Reh (probably from the Lahore division) examined by DR. BROWN, Chemical Examiner for the Punjab, gave materially the same results, with however different proportions as to the ingredients. They contained a large quantity of sulphate of soda, a small quantity of chloride of sodium, and a variable quantity of carbonate of soda. No soluble salts of lime or nitric acid were found, but some carbonate of lime and magnesia insoluble in water, and a small quantity of phosphate of lime.

The carbonate and sulphate of soda act deleteriously on plants in two ways: first, by rendering the water too saline to be readily taken up by the plants; and, secondly, it has the power of destroying and dissolving many organized substances. Moreover, these salts being efflorescent, they give off water to the air, leaving the ground hard, dry, and unfit for the growth of vegetation.

Some species of plants, however, appear to flourish in Reh soil. The "kikar" (*Acacia arabica*) thrives; the tobacco plant is cultivated, and I believe certain brassicaceous plants succeed. Among flowers, I have seen particularly fine growths of stocks on saline soil.

The analysis above given, exhibit the constituents of Reh itself after it has been formed and scraped up from the surface. The sub-soils of affected lands have been examined, and it is observed that the quantity of saline matter diminishes the lower we descend. At two feet below a surface containing 40 per cent. of Reh the sub-soil contained but 0.167 per cent, and at four feet only 0.144 per cent.

It has been confidently stated by several observers, that the Reh is in the soil itself, and is evolved by the action of water. COL. STRACHEY, R.E., in his memorandum insists especially on this. It cannot, however, be said that the Reh in its *formed state* as a mixed salt, exists all ready in the soil waiting for water to bring it out, since all the analysis of sub-soils hitherto made contradict this. If the statement were strictly accurate, it is obvious that it could be immediately proved: we have nothing else to do than to examine the soil *before* the Reh appears on it to disclose the constituents which, when acted on by water, would produce the efflorescence. Also when the Reh has appeared on the surface, an examination of the sub-soil at various depths ought to show (on the hypothesis) a difference in its constituents, from what the soil on which Reh had not yet formed exhibits. I cannot help thinking that we still require more accurate information as to the soils; and that it would be highly advisable to have analysis made of soils at various depths from places where Reh is likely to, but has *not yet* appeared; and also of soils from similar depths, where the reh *has fully* appeared on the surface. It must be remembered that the analysis hitherto made of the Reh surface itself, do not give us any clue to the manner of its formation, but only tell us what the substance is when it is formed.

With regard to the uses of Reh, I may say that it is employed, when abounding in carbonate of soda, for washing, and for making soap; also a crude glass is made from it. Ordinary Reh is used to mix with tobacco; and is extremely valuable in alum manufactures (see under head Alum, page 84) where it is called "Jamsan." The earth yielding carbonate of soda is called Reha, in Oudh, and is like the saji mitti of Bengal.* In order to make glass, the salt is scraped up and mixed with water in shallow round tanks a yard in diameter; more salt earth is added till the whole forms a kind of mud: this is left to the heat of the sun, and a white crust soon forms over the surface; the crust is removed, and a new tank formed out of the remainder: into this tank the crust first obtained is put and mixed with more reha earth. It is on the formation of the second crust that the soda is formed; it is taken off, heated to redness in crucibles to expel moisture, and is then melted into glass, as it already contains silica. Saji is formed from this reha by filtration, to remove the silicious particles.

III. Analysis of Canal River & Well Waters.

Thus far I have described the salt itself and the

* General Sleeman's, Diary of a Journey through the Kingdom of Oudh, 1849-50.



soil below it. It will now be proper to present a brief notice of the analysis of canal and well water, as an important part of the whole subject.

MR. MEDLICOTT'S analysis of the Ravi water shows

the existence (omitting insoluble and other substances) of 2·5 grains of common salt per gallon, and sulphate of soda 1·12, or of Reh, 1·46, being $\frac{22}{1000000}$. The Ganges and Jumna waters showed a similar result.

The following Table of MR. MEDLICOTT'S analysis will give a very good idea of the soluble ingredients of the water, the numbers exhibit the results from 10,000 parts of water.

Locality.	Time of collecting the water.	Carbonate of lime.	Sulphates.	Chlorides.
Ganges, at Hardwár.	13th June, 1861.	0·4731	0·10293	0·00539
Ganges Canal, Roorkee.	22nd May, 1861.	0·57	0·1747	0·0357
Ganges Canal, Roorkee.	4th July, 1861.	(?)0·57	0·12507	0·00232
Jumna, at Faizabad.	18th June, 1861.	0·1600	0·2428	0·0174
Eastern Jumna Canal, 96th mile.	18th June, 1861.	0·4285	0·0914	0·1500
Ravi, at Madhopúr.	Collected in bottles on the 1st and 18th Sept.; 3rd and 15th Oct.; 15th Nov.; 1st and 15th Dec.	0·4514	0·2042	0·0285
Ravi, at Madhopúr.	Do. do. do. 15th Jany.; 1st and 15th Feb.; 15th March; and 15th April.	(?)0·4514	0·4325	0·0348
Barí Doab Canal, at Nyázbeg.	5th July, 1861.	0·4357	0·14244	0·01832
Thames at Twickenham.		1·97	0·38	0·25

The detail of the analysis of one specimen may be given as an example: viz.; that of Nyázbeg (Lahore branch, Barí Doab Canal.)

Silica,	·0114
Carbonate of lime,	·3700
Carbonate of magnesia,	·0657
Chloride,	·0113
Sulphuric acid,	·0801
Lime,	·0368
Magnesia,	trace.
Soda,	·0310

With regard to the possibility of the concentration of the minute quantities of salt found in the waters, MR. MEDLICOTT'S estimate is as follows:—It is known that a soil containing 30 parts of sulphuric acid to 1,000 of soil, produces barren Reh land. 30 parts of sulphuric acid in 1,000,000 of water, by weight, may be taken as the greatest proportion con-

tained in the canal water. Taking 2 as the specific gravity of sulphuric acid, it would require an evaporation of 5,000 inches deep of water, to convert 10 inches cube of soil into Reh land. Assuming the annual amount of evaporation to be 10 feet or 120 inches (MR. MEDLICOTT adds that this is not high, since MAURY gives 15 feet as the amount in tropical seas, where the atmosphere is but little below the point of saturation, and not dry and arid as in the plains of the Punjab), we should then get rid of the 5,000 inches in 40 years. This period would be in fact much reduced by the contributions to the saline formation from drainage waters already charged with salt.

Dr. ANDERSON of Glasgow, reasoning from MR. MEDLICOTT'S original analysis, which gives 7·14 grains of soluble matter per gallon of water, (about half being alkaline salts,) observes that taking the

whole 7:14 as Reh, still the result would be only 1 lb. per 1,000 gallons. He says, "if we suppose the soil to be covered with water a foot deep, and the whole of it to be evaporated, it would deposit on an acre of land about 128 lbs., of alkaline salts (a little more than 1 cwt.), and reckoning the soil at 10 inches deep, it would weigh per acre more than 1,000 tons. The alkaline salts thus added to the soil would amount to $\frac{1}{1000}$ of its weight, a quantity which would not be perceptible." It must be remembered in connection with this statement, that no allowance is made for the long continued swamping during a series of years, in cases where the water comes up on to the land, and cannot get off except by evaporation, leaving all its salt behind.

IV. Remedial measures.

It now only remains to notice briefly the remedial measures which can be employed for restoring Reh lands.

Where the Reh first attracted attention, namely, along the Western Jumna Canal, COL. BAIRD SMITH was of opinion that the great remedy would be to re-align the canal along the natural water-shed of the country, and at the ordinary level, in lieu of the present high embanked level; this he accurately reasoned, would prevent the percolation of water, and the swamping that resulted from it. An opinion has rather widely been held of late, that canals should not only be at the level of the ordinary water-shed, but should actually be below it, even to a depth requiring artificial means of raising the water for irrigation purposes. This is not the place to discuss the wisdom of such an opinion, but it may be suggested that as far as experience goes, lands near canals, like the old Hasli, in the Lahore district, constructed at, but not below, the ordinary level of the water-shed, are usually found to be free from Reh efflorescence. It is admitted by the advocates of re-alignment, that drainage is to a certain extent a palliative and a cure.

DR. O'SHAUGHNESSY and MR. MEDLICOTT, both maintain that drainage varying in its plan according to circumstances, is the really efficient cure. Land affected with Reh, may be well washed, so to speak, by irrigation water, which will, if there is efficient drainage, soon run-off, carrying with it in solution the deleterious salts. In other cases the drainage being complete, the swamping which causes the concentration of Reh would be obviated.

With regard to the actual practice of the agriculturist in dealing with Reh land, it may be observed, that in many places drainage has been turned into good effect. If the Reh land is not very heavily impregnated, the natives give it constant ploughing, free watering and manure, and this generally renders the

land productive, at least of second-rate crops. Generally speaking the farmers assert that fully impregnated Reh land is incurable and valueless. In gardens and small plots, it has been found useful to dig out the soil to the depth of 2 feet or so entirely, and put in fresh.

Attention has been much directed to the discovery of some cheap manure, or chemical substance capable of being easily, produced in large quantities, which would neutralize the Reh.* His Highness the RAJAH OF KAPURTHALLA, offered a prize of Rs. 200, for the discovery of a remedy of this nature, but no success has been hitherto obtained. The nearest approach has been made by DR. BROWN, Chemical Examiner for the Punjab, who has demonstrated that nitrate of lime would succeed. Whether this can be made conveniently and cheaply, remains yet to be seen.

In the Lahore division the agriculturists make use of some natural salt efflorescences to correct the Reh. I should remark that every kind of efflorescence, be it carbonate, sulphate, nitrate, or chloride, is called by the general name of "kallar," a circumstance which causes no little confusion in considering the varieties of these salts. In the account of the manufacture of saltpetre, previously given, it will be seen that the terms "kalr" and "shor" are used variously for the crude material yielding nitre. In a very interesting paper by Mr. GARDENER, part of which is there quoted, the writer actually raised a question about the manufacture of common salt from saltpetre earth, denying that it was ever done and saying that salt is educed from "kalr." The fact is that both the nitrous earth and the Reh having a preponderance of chloride (which is what the "lūngars" of old used to make alimentary salt from) are called kalr. Common salt can however be obtained from both.

But to return to the subject. The Lahore people recognize three kinds of "kalr;" whereof the first is a very good remedy for Reh; the second, slightly so; and the third, is useless, and indeed deleterious. The first is called "chikna kalr." It is known by the damp brown appearance of the soil it comes up in; the second soil is called "kalr," without any qualifying epithet, and the third, "shora kalr." DR. BROWN found the *chikna kalr* to contain nitric acid and lime in a soluble form as nitrate of lime; it also contains sulphate of lime, probably some chloride of calcium,

* A plan has been suggested, which however, is perfectly fallacious, for covering the affected land with common lime. I have seen a paper setting forth this idea. Not only were the costs of the lime, labor, &c., totally miscalculated, but it is impossible that lime should have any effect in converting the sulphate of soda and chloride of sodium into substances beneficial, or at least not deleterious to vegetation.

chlorides of potassium and sodium, and sulphates of potash and soda. Besides these there is a little phosphate of lime and sesqui-oxide of iron with magnesia and carbonate of lime. The second sort of *kalr* has a similar composition, but contains less of the nitrate of lime. The third kind, the "*shora kalr*," differs in different specimens. DR. BROWN found some few to contain a little nitric acid and lime, but the majority none whatever. It contained sulphate of soda and potash, chloride of sodium, and sometimes carbonate of soda. This kind is probably *Reh* itself mixed with earth. "*Shora*," means saltpetre, but also salt merely (as "*daryá shor*," the sea, "the salt river.") The term *Reh* is not commonly used in the Punjab, but "*kalr*."

DR. BROWN describes the action of the nitrate of lime (from which the remedial agents derive their value) as follows :—"When the deleterious sulphates and carbonates are mixed with any soluble salt of lime, as the nitrate of lime, decomposition occurs and nitrate of soda is formed while carbonate and sulphate of lime are also produced. Carbonate of lime is insoluble in pure water and has no power of injuring plants, while nitrate of soda and sulphate of lime are beneficial in supplying them with nitrogen, the former by the direct decomposition of its acid, and the latter by absorbing ammonia from the air." Nitrate of soda and nitrate of lime are both deliquescent and keep the ground moist.

Nitrate of lime is formed wherever organic matter

decomposes in contact with carbonate of lime. Hence it is often found in old burial grounds, old walls (the mortar of which contains both lime and organic matter), and near cattle sheds. The crude nitre earth, "*shora*," contains frequently a proportion of lime, which is converted into nitrate of potash by filtering through wood ashes.

Nitrate of lime might be made by treating a mixture of *kankar* and water, with the impure but cheap nitric acid, made by distilling nitre and "*kahi*" (sulphate of iron earth) together.

The nitrate can also be obtained by mixing animal manure with chalk or lime in large heaps exposed to air but sheltered from the rain. The nitrates effloresce and are removed. In Europe it takes 2 or 3 years to get out all the nitrate from the heaps.

DR. BROWN has suggested the preparation of such beds (*nitriers artificielles**) at a safe distance from cantonments, where they could easily be supplied with manure from the barracks. In this way a large quantity of nitrate of lime would be formed, available for trying experiments, as to the actual effect on the *Reh* land *in situ*.

* In Europe these artificial nitre beds are usually constructed with a view to obtain nitrate of potash; for this purpose the ashes of plants are mixed with the heaps; these convert the nitrate of lime into nitrate of potash. In the country where nitre is abundant, the ashes would be omitted, the desired product being the nitrate of lime.

CLASS II. PRODUCTS OF THE ANIMAL KINGDOM.

Division I.—Animal Substances used as Food.

THE products of the Animal Kingdom, excepting the silk and wool departments, are by no means numerously represented.

This, however, is hardly to be wondered at, when we consider the present state of knowledge and civilization attained in the province. The mineral products of the soil, whether utilized or not, are still before every one's eyes in the districts where they occur, but it is not so in the Animal Kingdom. The most valuable products are seldom discovered at once, and it is only when the manufacturer begins to investigate the qualities of a substance, that he discovers the use first of one part, and then of another. Take the case of bone—there was no sample, either in the raw or manufactured departments, of the Exhibition, showing that the substance is even utilized. The proportion of the population that consumes flesh is probably less in this country than in Europe, but still the number of animals killed must be large, and the bones from this source alone form a very considerable produce. Now what is the case in Europe;—not a bone need ever be thrown aside. The finer kinds are cut into handles, buttons, and a thousand other articles: the chips and shavings that result from the manufacture are converted into size or gelatine, sometimes they are burnt for bone ashes or charred to form the bone-black and bone-brown, used as artists' colors; the coarser bones are readily used by the soap boiler, as yielding from their pores and medullary canals, a quantity of fat. When the fat is boiled out, there is a large yield of gelatine, and when that is removed, phosphate of lime remains. The phosphate of lime forms a most excellent manure, and therefore is valuable as it is; otherwise it is treated with sulphuric acid, which takes up the lime, and the phosphoric acid, being mixed in a retort with charcoal, gives phosphorous by distillation. Ammoniacal salts are also distilled from bones; and finally the bone burnt in a close furnace yields an animal charcoal, much valued in making water filters, and in the processes of sugar refining, for which latter purpose it is purchased as high as £16 and £17 a ton! This list of the uses of bone is by no means exhaustive, it only shows how one use is learnt often in the act of bringing into operation another; and how, until civilization and knowledge advance we cannot expect to find many specimens in our Economic Animal Kingdom.

In the food department we have little to notice, beyond a few samples of hard cheese from Peshawur and Kashmír. Honey is not included among animal products, because it is most highly probable, that the sweet substance or nectar from the flowers does not undergo any chemical change in the body of the bee, but is merely conveyed and collected by the insect, and is therefore best included in the class of vegetable saccharine products.

The preparation of dried or smoked meats, fish, or other forms of preserved animal nutri-



ment, is not at all consonant with the habits and customs of the people, who indeed, have no occasion for such articles: consequently, the class is totally unrepresented, save by a few samples of "ghí," or clarified butter.

Of animal substances used in manufactures, horn is found to be sparingly used for drinking cups; and fancy articles are occasionally met with, such as walking sticks formed of thin tubes of iron covered with pieces of black horn neatly joined. There were also exhibited (simply as trophies of the chase) some nice specimens of stags' horns, ibex horns, rams' horns, and antelopes horns.

Animal fats and wax are tolerably well represented: they are however so much in demand, because the majority of native soaps are made from vegetable oil; and with natives, oil lamps almost universally take the place of candles.

The Wool and Silk departments are well represented, and no further mention of this series is necessary till we come to the collections themselves. The art of leather dressing is abundantly practised. The number of barks and other substances suitable for tanning is great, and these substances are for the most part of wide distribution throughout the districts of the province; but the tanning is a rude process, and a thick hard leather is the result; the finer skins, such as kid and Chamois leather appear unknown as indigenous manufactures. The best leathers are made at Peshawur, or brought from Kábul, where the process of communicating a fine turquoise blue to leather is successfully practised in a kind of imitation Morocco leather. Russian leather finds its way to Peshawur, through the Kandahar and Balkh merchants.

Núrpúr, in the Kangra district, is celebrated for its red leather, called "lákhi." The Kangra district is also famous for a soft leather which is made into the pyjama, or trousers, worn by the hill people in the neighbourhood. At Kangra also, the art of dressing the skins of wild animals of the chase is most dexterously practised. Leopard and tiger skins may be obtained thoroughly tanned, and yet having all the hair and markings perfectly preserved on the upper surface.

586.—[4042]. Cheese, value two
seers per rupee. Peshawur.
LOCAL EXHIBITION COM-
MITTEE.

587.—[4043]. Cheese, called Kúrút;
price, three seers per rupee. LOCAL EX-
HIBITION COMMITTEE.

588.—[4044]. Cheese, called "panír
Káblí;" price, two seers per rupee. Kábul.
LOCAL EXHIBITION COMMITTEE.

589.—[4039]. "Ghí," clarified but-
ter. LOCAL EXHIBITION
Gujranwalla COMMITTEE.

This is exported in very large quantities from the jungle tracts of the "Bar" to the cities of Lahore and Amritsar. The amount exported annually from this district cannot be worth less than a lakh of Rs. When the cattle are sent out into the Bar to graze,

each large herd is accompanied by the agent of some shopkeeper or other: he advances money to the graziers, who in return let him have, every third or fourth day, the butter produced from the milk of their herds. This butter he manufactures into ghí, and sends off on mules or carts to the neighbouring large markets. This is a very remunerative trade, as may be imagined from the fact of traders being induced to advance money to graziers to ensure the product of their flocks. The ghí is generally sold at 25 per cent. above the cost of the butter.*

The cattle, whose milk is intended to yield ghí are carefully fed. COL. CLARKE gives the following account of the method of feeding cattle in Gujranwalla.

Milch buffaloes are fed with "mala patra," or the dried and bruised leaves of the wild *bér*, which much increases the quantity of ghí; green wheat and mustard, and maize, green with the ears on, and "joar,"

* Settlement Report of Gujranwalla.



also increase the quantity of milk. Cows that have lately calved, and whose milk is deficient, get milk mixed with goor (molasses); and also wheat and barley made by boiling into a kind of candle, called *kunji*.*

Ghi is much produced in the Punjab, and forms an important article of export along with rice and

sugar: it is of universal consumption among natives.

In the Hazára district there is, or was, a regular trade with ghi which was taken by traders in exchange for the salt they supplied to the Kashmir merchants.

590.—[4040]. Ghi, from Shahpúr, the produce of "the Bar." THE DEPUTY COMMISSIONER.

* Punjab Selections, II. 20.



Division II.—Substances used in Medicine.

A series was exhibited, prepared by HARSUKH RAH.

591.—[]. “Reg mahi,” a small mottled lizard, (*Lacerta seincus*, Linn.,) from 6 to 8 inches in length, found in the sands of Sindh and occasionally in dry tracts of the Múltán division.

This animal used to be formerly in the *Materia Medica* of Europe as a restorative, stimulant, and antisyphilitic; some modern Physicians have, however, justified the use of these animals.*

592.—[] “Mayá shutr ‘Arabi.” Rennet from stomach of camel.

The genuine article is brought from Arabia, and sells at a high price; the value of the quantity exhibited, about 4 oz., is Rs. 8.

593.—[]. “Jundi-be-dastar.” Two samples, first and second quality.

This is the dried *castoreum*, the matter contained within two glands of the beaver, affixed near the organ of generation in both sexes. These glands are sometimes erroneously said to be the testicles, from which they are quite distinct.

“The glands,” writes Moquin Tandon, “consist of two oval pyriform sacs of unequal size which open into the preputial groove by two large orifices. Those of the adult animal are at least 3 inches in length, sometimes 5. Those of the female are somewhat less developed. In the living animal the castoreum is an almost fluid unctuous substance of a strong penetrating and even foetid odour; when dried the sacs have a dark-brown color, and wrinkled appearance. Both American and Russian castoreum are known to commerce.

“Castoreum contains a peculiar substance, termed castorine, a volatile oil, salicine, carbonic acid, benzoic acid, albumen, fatty matter, mucus, carbonate of ammonia, and salts of soda and potash. In native medicine castoreum is supposed to affect especially the uterus, and is given also in hysteria and apoplexy; and it was formerly used in European practice. ‘Tincture castoric’ is still in the *Pharmacopœia*, but is not of much efficacy or value.”

* Moquin Tandon, *Medical Zoology*.

594.—[]. “Kharátin-khushk,” dried earth worms.

Collected in the rains and dried.

595.—[]. “Mahi rubián.” Dried shrimps, from the coast of Sindh.

596.—[2522]. “Mahi rubián ká kism.” Not known. Brought from the Sea Coast.

The sample is not a shrimp as the first is; in appearance consists of dried up pieces, having a gray color.

597.—[]. “Kirmdáná.” Cochineal. Imported from Bombay.

Cochineal is employed in European medicine to yield the *Syrupus cocci*, but only as a coloring agent with other tinctures, &c. (See Lakh, under Sub-class A).

598.—[]. “Nákhún” are shells.

599.—[]. “Bhír buti.” An insect of a beautiful scarlet color, resembling a piece of scarlet velvet.

Collected during the rains. They yield an oil, and have use similar to the cantharis, as a blister and irritant.

600.—[]. “Kekra,” are the carapace shells of crabs.

601.—[]. “Samundar khág,” (sea foam).

The dorsal plate of scopia, or cuttle-fish, and used as an absorbent and anti-acid; it is now in Europe only valued as a tooth-powder and in the arts. The bone contains 80 parts of carbonate of lime, according to the analysis of Dr. JOHN, and the soft part 85.

602.—[]. “Fádáníya,” are intestinal calculi, consisting of phosphate of lime, &c.

They occur in the intestines of various animals; and were in former days highly esteemed in medicine, under the name of bezoar stone. The genuine article was of an olive green color, and was extracted from a goat’s stomach. Persia was a celebrated locality.



603.—[]. “Mom,” uncleaned wax, from the hills.

604.—[]. “Sang-i-marjān,” coral.

Supposed to be a tonic. The old practitioners of Europe had the same idea in former days ; they administered it in the form of a bolus, electuary or powder, or as a draft and tincture, and they made use of a magistery, a precipitate of coral. Lémery considered it adapted to *renovate the heart*.*

There is a sample of a “Kushta sang-i-marjān,”

from Sirmūr, a pink powder, which is not coral, for it does not effervesce with acid.

605.—[]. “Mah-ul-luhm,” “essence of flesh.”
Peshawar.

“Mah-ul-luhm” is thus prepared :—The flesh of a young lamb being cleared of bones, fats, sinews, &c., is boiled in a moderate quantity of water, until only one-third of the water remains. This is strained off and such quantity of condiments or aromatic drugs added as may be deemed advisable. From this an essence is distilled, which is prescribed by native hakeems as a tonic. There are other various ways of preparing this substance, but the method just related is the most common.

* Moquin Tandon, Elements of Medical Zoology, p. 89.



Division III.—Substances used in Manufactures.

SUB-CLASS (A.) SKINS, FEATHERS, LEATHERS, HIDES.

A COLLECTION of skins and a few stuffed birds were sent to the Exhibiton, but principally for ornament as trophies of the chase. The list represents only a few of the Himalayan animals.

A few skins are made use of and exported. The otter's skin is prized for making caps; and also postins, or fur jackets.

The skins exhibited are principally from the hills around Kangra and Simla; a few of them are imported, such as the sable from Russia, and the Karakuli lambskins of Bukhárá;* these are used only sparingly in this country, the season seldom requiring them.

SKINS.

- 606.**—[5534]. Skin of chital, or spotted deer. Sirmúr. RAJA OF SIRMUR.
Simla.
Tigers skin. Do.
- 607.**—[5540]. Two foxes skins. CAPT. G. PENGREE.
Skin of Ibx.
Do. Barral. (Himalayan sheep).
Do. Thár. (Himalayan goat).
Do. Kakar. (Barking deer).
- 608.**—[5551]. Leopard's skin, "mirgh." Kangra hills. KANGRA COMMITTEE.
Kangra.
- 609.**—[5552]. Bear's skin, "bhálú." Do.
- 610.**—[5553]. Flying squirrel, "sain." Do.
- 611.**—[5554]. Skin of muskdeer, "bina." Do.
- 612.**—[]. Armadillo, "salgar." from Tirah Sujánpúr.
- 613.**—[]. Otter skin, "'udh."
- 614.**—[5572]. Fox's skin, "lomri," Spiti. KANGRA COMMITTEE.
- 615.**—[]. Stuffed "gural," chamois. Kúlú. KANGRA COMMITTEE.
- 616.**—[]. Stuffed "karth." Kúlú. KANGRA COMMITTEE.
- 617.**—[]. Wild cat, "ban billi." Kúlú. KANGRA COMMITTEE.
- 618.**—[]. Pole cat, stuffed. MR. PRINCE, Kangra.
- 619.**—[]. Tiger cat, stuffed. MR. PRINCE, Kangra.
- 620.**—[]. Porcupine, "seh," or "sáhi." Kúlú. KANGRA COMMITTEE.
- 621.**—[5654]. Tiger skin. CAPTAIN Muzaffargarh. HAWES.
Killed in the Muzaffargarh district.
- 622.**—[5665]. Hogdeer's skin, "párhá." (*Cervus porcinus*). CAPTAIN HAWES.
- 623.**—[5660]. Otter's skin, "saglahú," "sag-i-abi," (lit. "water dog") from the Indus. Bunnoo. DEPUTY COMMISSIONER OF BUNNOO.
- These otters are occasionally found, and the skins used for fur caps, postins, &c., &c.

* Called so from Karakul, a province 2000s south of Bukhárá; as much as 10 lacs worth of these lambskins with the hair on, are exported to Persia, Tartary, Kábul, and India; other districts of Bukhárá produce them, but all are called Karakuli. DAVIES' Report, Appendix XXII.

624.—[5629]. Large white fur.
Bukhára? LAHORE MU-
SEUM.
Peshawur.

This is in all probability an imported Russian skin.

625.—[5673]. Sable, "sanjáb." Rus-
sia. ATMA SINGH.

626.—[5679]. Skin of ibex. "Kel."
Hazara. Kághán. DEPUTY COM-
MISSIONER.

627.—[5680]. Skin of large rat. Ká-
ghán. DEPUTY COMMISSIONER.

628.—[]. Stuffed black buck.
Gugaira. TEHSILDAR OF GUGAIRA.

Stuffed foxes. TEHSILDAR OF HARIPUR.

Weasel, "niyal."

Hare, "khargosh."

Deer skins.

FEATHERS.

These are very little made use of in the Punjab; the down is never used for stuffing pillows and beds as at home, nor are feathers ever used as ornaments, save that one kind of bird, the "onkár," furnishes its narrow black wing feathers to make what are called "kalgi," that is plumes for the top of the "khod," or helmet; these consist of a number of the narrow tapering black feathers stuck upright in a ring into a holder, something in the way of the feathers of a shuttle-cock. The holder is covered with gold thread, and sometimes has pearls sewn on to it. These plumes have a very elegant appearance; they stand about 6 or 8 inches above the helmet. The feathers of the "obára" (*Houbara macqueenii*) are similarly used.

The collection contains a series of stuffed birds from the hills, showing the "múnál," or hill pheasant, the snow pheasant, one species of partridge, the "chakor," and others, which are not made any use of.*

The only application to use of birds' feathers appear in the Kashmir collection, where

there are warm jackets made up of the skins of a kind of bird [No. 7728], apparently a water-fowl.

629.—[5671]. Feathers (Persia?)
Peshawur. LOCAL EXHIBITION COM-
MITTEE.

"Pari-go," worth Rs. 3 a seer.

630.—[5678]. Skin of the golden
pheasant (*Thaumalea pic-
ta*) Kághán. DEPUTY
COMMISSIONER.

631.—[7728]. Warm coat made of
Kashmir. the skins of water-fowl.

LEATHER AND HIDES.

The leathers that are met with in the Punjab are either of local manufacture, European, or have found their way from Peshawur and the North-West Frontier and Russia. European leather is seldom seen, except in the saddlers and bootmakers, who make European articles. Russian leather occasionally comes to Peshawur, and is called "balghár."

There is a kind of leather having a metallic lustre, and called "kimsana," imported also from the north-west; and a beautiful leather, used in the manufacture of the bright blue green shoes from Kashmir and Peshawur, which is called "kimakht." This is not made

A pair of the Argus pheasant (*Coriornis melanoccephala*).

A pair of "múnál" (*Lophopterus Impeyanus*).

A snow pheasant (*Tetraogallus himalensis*).

Pair of "khalij" pheasants (*Gallophasid Alboeristatus*).

Pair of "chir" pheasants (*Phasianus Wallichii*).

Snow partridge (*Lerwanivicta*).

Chakor (*Perdix rufa*) *Caecabid Chakor* (Jerdon).

The bird is said by natives to be enamoured of the moon, and that at full moon it eats fire.

Hill pigeons (*Columba castotis*).

Black birds (*Merula boubout*).

"Kokila" (*Eudynamis orientalis*).

A peacock (*Pavo cristatus*).

The following were sent by the TEHSILDAR, Káid.

"Múnál" or "nilgir" (alive.)

Hen, do.—

Cher or Charir pheasant.

Black birds (*Merula*).

Titars (*Perdix francolinus*).

Chakors (*Perdix rufa*).

* The following birds, stuffed, were exhibited by MR. PRINCE of Kangra, from the hills about Kangra.

in the Punjab. Several of the Peshawur sword scabbards were covered with a black leather, looking like morocco; it is probably an imitation.

The skins locally prepared are goat skins, calf and bullocks' skins, and camels' skin, which last dries into a very hard compact hide, and is made into "kuppas" and oil vessels; also into dishes for weighing scales, &c. Nūrpūr, in the Kangra district, is celebrated for its preparation of red dyed skins, especially goat skins; they used to form a considerable article of trade, and went to the frontier to Yarkand by Ladākh, and still do so to some extent. Some of the leather articles exhibited show a considerable knowledge of leather-working, and are very soft; but there is nowhere exhibited any specimen approaching to kid, or like the useful chamois leather; the latter is indeed to be found in the Punjab, but only as a European import. Leathers are ordinarily met with dyed black and red, the latter being especially common, more rarely it is left of its natural color, for shoes, &c.

632.—[5523-26]. Series of leathers.

Delhi. (a.) Bullock's hide.

(b.) Skin of kid.

(c.) Camel's hide.

(d.) Buffalo hide.

633.—[8213]. Leather for shoes.

Kurnal. LOCAL EXHIBITION COMMITTEE.

Sirsa.

634.—[8219]. Hide. BANSIDHAR.

635.—[8249]. Goat skin, dyed red: value, Rs. 1, from Nūrpūr.

Kangra.

LOCAL EXHIBITION COMMITTEE. The description of this manufacture is contained in Vol. II. Class XI.

636.—[8263]. A kakar skin: worth Rs. 2-4-0. Hushyarpūr.

Hushyarpur.

BALU.

Gujranwalla.

637.—[5635]. Buffalo skin.

638.—[5634]. Goat's skin.

639.—[5637]. Bullock's skin.

640.—[8302]. Two skins of red leather. GUJRAT. UMRAH.

641.—[8304]. Five skins of black leather. UMRAH.

642.—[8338-9]. Leathers, from Syadwalla. LOCAL EXHIBITION COMMITTEE. GUGAIRA.

643.—[8334]. Red leather, from Hurrapa. LOCAL EXHIBITION COMMITTEE.

644.—[5681]. Hide, from Palki. DEPUTY COMMISSIONER OF HAZARA. HAZARA.

The skins are soaked first for 15 days in water and lime, after which it is cleaned and the hair removed: the skin is then sown up, leaving one aperture, and filled with particles of oak or cheer bark or bān (*Rhus cotinus*) leaves, and on these water is constantly poured until the skin is thoroughly saturated; the price is about Rs. 1 per hide.

645.—[5672]. Sheeps' skin, "khal." Peshawur. LOCAL COMMITTEE.

Used for making shoes. When the hair is not removed, they form postins.

The soft black lamb skins of Karakul, before alluded to, are immensely prized for making postins and for coats: they are prepared by taking the skins of the young lambs immediately on their being born: this of course is an expensive method, and the skins are proportionately high priced.

646.—[8361]. Russia leather, "balghār," imported to Peshawur: value Rs. 25. MUNICIPAL COMMITTEE.

This leather is said to be made of the horse's skin, it is thick but pliant, and of most grateful fragrance. The skins are much valued for the preservation of merchandise, as insects will not attack them.

647.—[8362]. Green leather, "khal sabz." Kābul. Rs. 1-4 the piece. LOCAL COMMITTEE.

648.—[8363]. Imitation morocco. Kabul. Rs. 2 the piece. LOCAL COMMITTEE.



649.—[8364]. Black leather. Peshawur. Rs. 2-8 the piece. LOCAL COMMITTEE.

650.—[8366]. Another sample: worth Rs. 1.

651.—[8268-69] Inflated skins, "shiráz,"

These skins are used for crossing hill streams. They

consist of the entire hide of the animal (buffalo) or (bull), with the apertures of the legs, neck, &c., carefully tied up. The passenger throws himself on one of the skins, which remains under his middle, he then propels himself by striking out with his legs and arms.

652.—[8348-8349].* Leather, by the Dera Ghazi Khan. TEHSILDAR AND MUNICIPAL COMMITTEE.



SUB-CLASS (B.) BONES AND HORNS.

ALREADY we have noticed the comparatively little use made of animal products. Bone is scarcely used at all, nor is there any specimen of it exhibited as used in any manufacture.

There is one specimen of ivory; an account of this will be found in Vol. II., under the head "Ivory manufactures."

Simla and Kangra exhibited several horns, as ornaments.

653. []. Two pairs of ibex horns, "tungror." Kúlú and Lahaul. LOCAL COMMITTEE.

654.—[]. Two pairs "thár" horns, called "karth." Kangra hills.

655. []. Two horns, "singh kurrál." Kúlú.

There were also other horns (not catalogued) of the

"thar," "gural," buffalo, yák (*Poephagus grunniens*); some fine stags' horns, several of them from Bunnoo; but all exhibited as ornaments.

656.—[9260]. Elephant's tusk, Sirmúr. RAJA OF SIRMUR.

This is a large fine piece of ivory cut at both ends, about 2 feet long.

657.—[]. Stags' horns, "shákh-i-Gugaira. DEPUTY COMMISSIONER.

658.—[]. Buffaloes' horns.

SUB-CLASS (C.) ANIMAL FATS AND OILS, INCLUDING WAX.

FATS.

- 659.**—[2511]. Bears' grease. Kangra hills. LOCAL COMMITTEE.
- 660.**—[2512]. Leopards' grease. Kangra hills. LOCAL COMMITTEE.
- 661.**—[922]. Suet. Gugaira. LOCAL COMMITTEE.
- 662.**—[923]. Bullocks' fat, prepared. LOCAL COMMITTEE.
- 663.**—[924]. Buffaloes' fat, prepared. LOCAL COMMITTEE.
- 664.**—[925]. Tigers' fat. LOCAL COMMITTEE.
Used medicinally.

OILS.

- 665.**—[4211]. Wax oil, "raughan-i-mom." LOCAL EXHIBITION COMMITTEE.
Amritsar.
- A strong smelling oil, its odour exactly resembling that of a candle when suddenly blown out. A sample was sent from Dera Gházi Khán.
- 666.**—[4296]. Raughán-i-bhírbhúti. Lahore. RAM SINGH, Pansári.
- Oil of the red velvet insect, "bhír bhúti," that appears in the rains; the oil is used only in medicine, or as an irritant and blistering agent.
- 667.**—[4400]. Raughan-i-pín. "pelican oil." TEHSILDAR OF DERA GHÁZI KHAN.
- Price, four chitacks per rupee. The bird is found the Indus at Mithankot, and the oil is made from

its fat; one bird yields a quarter of a seer. The Persian name of the bird is *Fitan*.

- 668.**—[4267]. "Raughán-i-baiz-murgh." Lahore. RAM SINGH, Pansári.

Oil from the shells of hens' eggs, obtained by dry distillation; used only in native medicine.

- 669.**—[4409]. Scorpions' oil. TEHSILDAR OF DERA GHÁZI KHAN.

This is made by steeping scorpions in oil; is used in medicine and as a cure for scorpion's bites: price 4½ tolahs per rupee.

WAX.

- 670.**—[2499]. Wax, from Rewari. DEPUTY COMMISSIONER, Gurgaon. GURGAON.
- 671.**—[2506]. Wax, from hills near Simla. MR. GEO. JEPHSON.
- 672.**—[5630]. Purified white wax, from the hills near Gurdaspúr. C. A. D. GORDON, Esq.
- 673.**—[5631]. Candles, prepared from hill wax. Lahore bazar. B. POWELL, Esq.
Amritsar exhibits wax, No. 2515.
- 674.**—[2533]. Wax. Jammú. H. KASHMIR. H. THE MAHARAJA.
- 675.**—[4168]. Wax. Dera Ghazi Khan. TEHSILDAR.
- 676.**—[]. Wax. Hushiarpur. LOCAL COMMITTEE.



SUB-CLASS (D). ANIMAL FIBRES.

I. SILK.

WE now come to the most important class of animal products, the only one which was tolerably fully represented in the Exhibition. Silk has been a product of India* from time immemorial, as also for a great length of time in Bukhára, in Kashmír, to which places it was probably at some remote period introduced from Khuttan and China.

The specimens of silk exhibited are all the produce of the cultivated silk worm (*Bombyx mori*), the eggs having been obtained principally from Kashmír, Kábul, Bukhára, and some few from Bengal.

It would be foreign to the purpose, and would quite exceed the limits of this work were I to attempt a history of silk, or an account of the rearing of silk worms. I have merely given here and there in the following list such particulars concerning the methods of cultivation followed in different districts, as may serve to show what are the facilities, and what the obstacles, to sericulture; and to what extent success has hitherto been obtained in the Punjab.

Indeed there is little to be said on the subject of silk rearing that could be of any practical value, unless I were to go minutely into such details, as could only find place in a manual, or work especially devoted to conveying this information.

The main requisites for the successful rearing of the worms appear to be light well ventilated dry rooms, furnished with series of shelves around the sides on which the trays containing the feeding worms are placed,—a temperature equable and moderate,—and freedom from the attacks of animal and insect vermin.

The principal source of silk in these provinces, and in those on the north-western Frontier, which yield the great supply for the manufactures of Baháwalpúr, Múltán and Lahore, is, as already intimated, the cocoon of the *Bombyx mori*, or *Phalœna Bombyx mori*.

The Eria and Tussah silks are unknown. Yet wild silk is altogether unrepresented. At first a wild silk worm was noticed near Masúrí, by CAPT. HUTTON, which MR. WESTWOOD the entomologist pronounced distinct from *B. mori* and named *B. Huttoni*; since then, LORD W. HAY, noticed wild silk worms in the Simla States, called by WESTWOOD, *Caligula Simla*; and in the Seeba territory of the Kangra district, MR. R. SAUNDERS writes† that, there are wild cocoons which are cut into thin bands or strips, and used to bind musket barrels on to the stock, such is the strength and tenacity of the compacted fibre of the cocoon. A similar use is ascribed to the Tussah silk (*Antheræa paphia*, Linn.) in the Madras presidency.‡

* The exports of silk from all India to all parts of the world have been, and value during the years, as follows:—

1850-51	Rs. 61,93,180	1856-57	Rs. 78,21,390
1851-52	„ 68,86,400	1857-58	„ 76,66,730
1852-53	„ 66,75,460	1858-59	„ 79,92,520
1853-54	„ 64,24,760	1859-60	„ 81,78,530
1854-55	„ 50,01,060	1860-61	„ 1,08,67,260
1855-56	„ 70,77,050		

(FORBES WATSON'S TABLES.)

† To the Curator, Lahore Museum, 1859.

‡ Jury Report on Animal Products, Madras Exhibition of 1855, p. 73.

The wild worms feed principally on the bér (*Zizypus jujuba*). MR. MACLEOD succeeded in collecting a number of these cocoons for a merchant (MR. LOTTERI) in Calcutta, who produced very beautiful raw silk from them. MR. COPE has also reeled some of this wild silk. The process is not difficult, if the cocoons are boiled in water with any animal substance containing ammonia.

Whether the Simla and Masúri species were ever cultivated or made use of formerly, it is impossible to say, but silk cultivation in this part of the territory now called Sirhind, appears to have been practised of old, being mentioned by JUSTINIAN.*

There is scarcely any Fibrous product either animal or vegetable, that is so curious as silk, both as regards its natural history and as regards the progress of the trade in it.

Silk first become known in Europe after the victories of Julius Cæsar, by his displaying a profusion of Chinese silks at a magnificent spectacle which he gave in the theatre; soon after this, small quantities of the manufactured article began to be imported, and were sold at the most exorbitant rates. Tacitus (Annals, II., 33) mentions that during Tiberius' reign, a law was passed to prevent men wearing silk garments, but latterly, under Heliogabalus, who clothed himself entirely in silk, the law fell into disuse; from that time forward silk became common, till about the year 370, it appears from a statement of Ammianus Marcellinus, to have been in common use even by the lowest orders. A large profit was then derived by the Chinese exporters of silk from the Western Empire, but at last eggs were clandestinely brought over to Constantinople in 550 A.D., and soon the manufacture spread to Greece. Thence Roger II., king of Sicily, after having ravaged the Peloponesus and Greece, carried back with him the knowledge of silk cultivation, which he established at Palermo whence it spread into Italy, Venice, &c. It seems also early to have been established in Spain. It did not reach France till about 1480, and the manufacture of silk at Lyons began in 1520.

England has never been a silk producing country, though the experiments of MRS. WHITBY, of Newlands, seem to show that by introducing a species of mulberry that bears leaves early in the season, such as *M. multicaulis*, the cultivation is quite practicable. Silk manufacture has however been carried on for ages, and has a peculiar interest from the experience

* The number of known species of silk producing worms is very considerable. The following is a list, which, however does not profess to be exhaustive.

Bombyx mori Linn. (*Phalæna*).

B. croesi, Bengal.

B. textor (Hutton), Masúri.

B. huttoni (Westwood), Do.

B. horsfieldi (Moore), Java.

B. sinensis, Bengal.

B. religiosa (Helfer). The Joree worm of Assam.

Ocinara dilectula (Walk.), Java.

Attacus Atlas, Linn. (S. Atlas), China, &c.

A. Edwardsii, Sikhim.

A. guerini (Moore), Bengal.

A. Ricini, Assam.

Ailanthus (*Attacus cynthia*, Drury), Moore's cross between the Erie of China and that of Bengal, 1859.

Attacus cynthia, Drury, "Eria," China, Bengal, Assam.

Antheraea mesankooria (Moore) "Mizankúri silk."

A. Pernyi (Guer.-Men), N. China.

A. Perrotteti (Guer.-Men), Pondicherry.

A. Boylei (Moore), Masúri.

A. Helferi (Moore), Darjeeling.

A. Jana (Cram.), Java.

A. Frithii (Moore), Darjeeling.

A. Larissa (Westwood), Java.

A. Paphia, Linn. (*Saturnia Paphia*), "Tussah" silk.

A. Assama, (Helfer), "Moogha" of Assam.

S. Silhetica, Dacca and Silhet.

Saturnia pyretorum (Westwood), China.

S. Grotei (Moore), Darjeeling.

Loepa Katinka (Westwood), Java.

Actias Selene (*Saturnia selene*), Darjeeling, Masúri, and also S. India, where it feeds on the *Odina woder* "jinjan."

Caligula Thibeta, Masúri.

Caligula Simla, Simla.

Cricula trifenestrata, Java.

A species of *Lasiocampus*, feeding on the "Jáman" (*Sisyygium jambolanum*), and the Guava tree, is noticed in the Madras Report of 1855, p. 74.



it affords of the effects of a series of legislative blunders on a trade. The manufacture of silk comes prominently before us in the reign of Elizabeth, when the influx of workmen from the Low Countries gave a great stimulus to the trade. The silk "throwers" (those who prepared, by twisting, the silk fibres) were incorporated as a guild in 1629; and then began a series of legislative enactments each of which served only to augment the evil produced by the last. During this interval in 1685, the revocation of the Edict of Nantes, sent thousands more workmen to Spitalfields, and of course greatly increased the manufacture. To stimulate, as it was thought this manufacture in 1697, the importation of French and foreign silks was prohibited; and in 1701, the prohibition was extended to India and China goods. The effect of this was two-fold; first, it stopped all advancement of the manufacture to such an extent, that no one took the slightest pains to improve the looms or other machinery; so that in 1826, when at last the evil of the system was discovered, it was stated in Parliament, that there were abroad looms for ribbons, that could produce five times the quantity in the same time that the Coventry looms did! Secondly, the law proved utterly impotent to stop the importation, since it was calculated that between 1688 and 1741, when the prohibition was in full force, the imports were worth £500,000 *

In 1719, the first throwing mill was established at Derby, the machinery for twisting the *organzine* and *tram* silks, long used in Italy, having been clandestinely copied and brought to England. Accordingly, not only was the importation of silk fibres prohibited, but also of silk thread and *organzine* too. All these acts were crowned by the Spitalfields Act of 1773, which as McCulloch observes, "after having done incalculable mischief," was repealed in 1824. This fixed a rate of wages for workmen, *more or less* than which neither master could offer nor workmen accept. At last, in 1820, the effect became visible: England had equalled and rivalled her neighbours in all manufactures, *except silk*, in this no improvement had taken place! We were behind our other manufactures, and behind all our neighbours. In 1826, the majority of foreign silks were imported with a duty *ad valorem* of 30 per cent.; this rate gave great freedom for smuggling, since counting all the risks of illicit trade, they only amounted to 15 or 20 per cent. on the value, and hence the illicit trade was more profitable with its risks and all, by 10 per cent. than the legitimate; this evil was however subsequently rectified, and the duty so reduced as to render smuggling unprofitable. There seems to be no doubt that England will not rival France as a silk manufacturing country; the delicate colors and superb finish of Lyons silks ever place them above competition.

The chief difficulty attendant on the rearing of silk worms appears to be the growth of suitable trees for their food. This has been felt in England as it has in the Punjab, but there is certainly a very wide field for enquiring as to the possible sources of nourishment: it has been often observed that caterpillars found on one kind of plant, will readily eat leaves of other species, but of the same natural order. Several species of *Bombyx* yielding silk in Assam and other places, live on the poplar and the *bér*.

Pípál, *Ficus religiosa*, is of the same natural order as the mulberry; it would be worth while trying whether the silk worm could not live on pípál leaves, to supplant mulberry. The *bér* tree (*Zizyphus jujuba*) abounds, and some species of *Bombyx* feed on it; perhaps others would also.

It is now time to proceed with a brief notice of the various attempts made to cultivate

* McCULLOCH'S Dictionary of Commerce. Art. Silk.

silk in the Punjab up to the present time, reserving notices of the manufacture of silk fabrics, as it at present exists, to Class VII., in Vol II.

The cultivation of silk certainly deserves to be perseveringly followed out in the Punjab. Not only is the Punjab the seat of silk manufactures of the first class—at its cities of Multán, Lahore, Amritsar, and the neighbouring state, Baháwalpúr—but it borders on Kashmír, long known for its productiveness in silk; and receives the trade of Bukhárá, the dyed and floss silks of which have been famous for ages. In our own times, much encouragement has been given to the introduction and cultivation of silk, both in Bengal, in the N. W. Provinces, and the Panjab.*

The Punjab seems especially suited for silk worms, particularly certain districts of it. The only difficulty as far as climate is concerned, is the great heat of the summer months. Everything but great heat the worms seem to stand. Silkworm cultivation has been accomplished in Sweden and in Canada; in England also attempts have been made. An English lady, MRS. WHITBY, of Newlands, has demonstrated the practicability of the English cultivation; she exhibited silk, hand-reeled, to the British Association, and a splendid piece of silk woven from her British cocoons was, it is said, presented to Her Majesty the Queen.

The difficulty in England, (and this is felt also in other climates,) is that the ordinary species of mulberry produce leaves too late in the season, and the young worms are hatched *before* there is food ready for their consumption; but MRS. WHITBY, overcame the difficulty by planting the species known as *Morus multicaulis*, which produces its leaves earlier than other species. There seems no reason then that sericulture should not be carried on in the submontane districts of the Punjab, and even in many of the plain districts themselves; and it is encouraging to notice how the experiment has been determinately maintained, notwithstanding occasionally failures. Loss and disappointment will occur, in almost every new undertaking, at one stage or another, but happily we know by experience, that such difficulties are often the forerunners of unexampled success, and that they do not necessarily imply or prove that the theory is either faulty in principle or impossible in practice.

As early as 1847, silk rearing was attempted at

Lucknow, by CAPT. HOLLINGS, who had received a supply of cuttings of the *Morus multicaulis* from Calcutta; the experiment was however suffered to drop when CAPT. HOLLINGS left Lucknow. More recently the experiment has been taken up with zeal by DR. BONAVIA, some of whose cocoons are exhibited from the Lahore Museum.

Much earlier experiments were however made in the Punjab, and earliest of all in the Cis-Sutlej States. So far back as 1836, DR. GORDON, Assistant to the political agent on the N. W. Frontier, commenced work. He built a silk house, and planted mulberry trees, which still exist; he carried on his experiments for three years, the latter year appears to have been the most successful. Owing to DR. GORDON's transfer to another appointment, the experiment gradually fell off.

Among the hill states, LORD HAY, noticed in the valley of the Giri some wild silk worms,* which formed their cocoons in the rainy weather, and as mulberry trees abound even up to Simla itself, there can be little doubt of the success which would attend the cultivation of silk. MR. COPE, of Amritsar, mentions the valley of the Gambhír, including Sabáthú, as a likely place. Sirmúr and Kánawar might also be added.

At Ludhiana silk cultivation was attempted by COL. SIR CLAUDE WADE, who tried with some eggs obtained from Ladákh in 1836, by DR. ANDERSON. This experiment was also cut short after two years by the departure of its originator to Kábul.

At Hushyarpúr, COL. ABBOTT, the Deputy Commissioner (1852), attempted to rear the worms in the jail; he obtained 56 seers of cocoons, of which 32 seers were wound off, 8 seers were of coarse silk, 4 seers from the pierced cocoons, and 2 seers were of floss. COL. ABBOTT's departure for England, drew this experiment also to a close.

At several localities within the Kangra district, silk appears to have been attempted. MR. MACLEOD, then Commissioner of the Trans-Sutlej States, writing of this part of the country says;—"I would at the same time point out the peculiarly eligible position of Núrúpár (in the Kangra zillah). It is situated at the foot of the hills, possessing as compared with the lower plains of the Punjab a mild climate, and

* The importance and value of the silk trade is not easily over-estimated. As far back as 1852, the imports from all quarters were 7,248,024 lbs., of which 2,466,605 lbs. came from China, 1,335,951 lbs. from Bengal, and 3,445,448 lbs. from other parts. No doubt the estimates of later years would show a very much larger quantity even than this.

* Both at Simla and Masúri a wild species of silk worm, named by MR. O. WESTWOOD, *Bombyx Huttoni*, has been observed on mulberry trees, they produced small cocoons from which silk was reeled by MR. COPE.—See his Pamphlet on Silk, addressed to A. H. Society of the Punjab.

it is the seat of a very large colony of Kashmiris, actively engaged in the shawl manufacture; one of these, some years ago, set up an establishment for rearing silk worms, as a means of livelihood, which however the unsettled state of the times and his own poverty obliged him to discontinue; but he is anxious to resume it if encouraged."

Silk has been produced in the Mandi state. At Pattar Kot, on the verge of the district, in 1854, ALI BAKSH set up a manufactory, and produced some fine cocoons.

At Sujanpūr in 1852 and 1853, there were several Mussulmans, who for 8 or 10 years previously had obtained silk and sold it at Batalā for Rs. 11 per seer pukka; a similar effort was made at Mainakot. MR. BARNES, then Commissioner of the Lahore division, expressed strongly his opinion that silk could be produced in any quantity, and that Government should set the example of its cultivation. He added, that the Mainakot and Sujanpūr silk factories were proofs that the silk can be reared by the poorer classes with the certainty of profitable returns.

The cultivation at Sujanpūr, owing to the death of the proprietors, has disappeared.

At Amritsar, in former days, SIRDAR DESSA SINGH, father of LEHNA SINGH, reared some eggs he got from Kābul, and produced silk worth Rs. 7 or 8 a seer; but he only reared for his amusement and from curiosity. Of the present cultivation at Amritsar, I shall speak hereafter in noticing the specimens contained in the collection. In the same way also, the account of sericulture in the Gurdaspūr district under the management of JAFIR ALI is reserved for the sequel, under the head of JAFIR'S exhibited samples.

At Lahore in 1853, an attempt was made on a somewhat larger scale: eggs were obtained from Bengal, and an expert Superintendent was sent up.* Kashmir eggs was also obtained, and it soon became evident that they were far better suited to the province than the Bengālī eggs. In 1856, the number increased greatly, in fact it became beyond the power of the gardeners to supply fresh leaves enough. A large number of eggs and worms died, and what with other costs, the out-turn of silk, (Rs. 11,000,) was rather inadequate. There was about 5½ maunds of wound silk, and that of excellent quality.

At Gujranwalla, a man kept some worms reared from eggs he had obtained in Hazara. For three years he kept them for his amusement, but afterwards dropped the cultivation.

At Gujrat also the experiment was tried.

In the Rawalpindi district, at Syadpūr, below the Hazara hills, a silk factory was started. It belonged to MIRZA SHAHWALI, the descendant of the Gukurs, whose ancestors in their palmy days planted an extensive garden of 1,500 or 2,000 trees, the greater part of which were destroyed by the Sikh army in 1848-49, owing to the MIRZA'S strong fidelity to the British cause. With the remainder, he established a small factory, which yielded him 5 to 6 seers annually which sold for 18 to 20 Rs. per seer, at Peshawur. MR. CARNAC adds, that there are many other localities in this district, enjoying the same irrigation advantages as Syadpūr, and situated at the end of the same range, commencing below Ghāzī on the Indus, and extending below Gandghar and Khānpūr to Gungalli in the Jhilam.

With regard to Peshawur, COL. JAMES, writes rather unfavorably; he states that the quantity produced at Peshawur was never large (not more than 4 maunds, and that of a coarse quality) and he thinks that the landowners would not be likely to take to planting mulberry gardens; he mentions that in Bukhārā and Kābul, the mulberry is grown from seed, by rubbing the seed into the twists of a rope, which is laid down in the earth; the young trees are allowed to grow till they are 4 or 5 feet high, when they are cut for use.

This unfavorable opinion is however scarcely justified by the results of the recent experiments in Peshawur, the details of which will be given in connection with the notice of the Peshawur samples under this class.

The principal districts of which silk is imported into the Punjab are Bukhārā and Kashmir: the silk is imported both raw and in skeins ready dyed; and notices of the various kinds are given in the sequel, under the headings of Kashmir and Bukhārā silk. The silk trade in the Punjab is of great value, it is stated by MR. DAVIS, to be nearly £200,000.* "Raw silk," he adds, "is imported from Kokand, Bukhārā, Balkh, Khulm, Akheha, Shibrgaum, Andko, and Kashmir; from Saidābād, Murshedābād, Rampūr-Baulia, and Rādhānagi, in Bengal, and China *via* Bombay. No silk has been imported from Khutan, for the last four or five years. The raw silk is sent from Amritsar to all parts of the Punjab for manufacture: raw silk is the staple import by way of Kābul.†

* DAVIES' Report on the Trade Resources of the N. W. Frontier, p. 74.

† The above information is collected from a variety of sources but especially from "The Selections of the Punjab Government Correspondence;" MR. DAVIES' Report; and MR. COPE'S Lectures and Pamphlet on Silk in the Punjab, addressed to the, Agri-Horticultural Society, also from LIEUT. POSTAN'S Memo. on the Silk Trade between Shikarpūr and Khurāsān

* This Superintendent, M. DEVERINUR, sent home some of the silk, which gained a prize at the French Exhibition, 1855.

CHEMICAL NOTICE.—Silk is secreted in a double filament from two orifices at the head of the worm, communicating with two secreting glands one on each side; as they pass out the two filaments are glued together into one by the secretions from a third central gland, of a resinous substance.

The yellow color of silk is attributed to resinous matter: accordingly a method of bleaching has been occasionally practised, which consists in removing the color by treating the silk with alcohol of a fixed specific gravity, acidulated with muriatic acid; after treatment the silk is washed with alcohol, and thus is rendered white, the alcohol acting as a solvent to the resinous coloring matter, and the chlorine of the acid aiding the bleaching. The spirit can be recovered, to prevent waste, by neutralizing the acid with lime, and distilling the liquid, when pure alcohol passes over. The more common method is to tie up the silk in cotton bags, which are boiled for some time with soap, and bleached, and as a finishing process, hung up in a kind of oven exposed to the fumes of sulphur.

The native process is similar to the latter. After boiling in a solution of sajji (carbonate of soda), the silk is washed several times with soap and water, and finally exposed as in Europe to the fumes of sulphur. It loses much weight by this operation (4 or 5 chittacks out of 16), showing that the coloring substance is a separable and ponderable substance, not inherent in the silk.

The solubility of silk is a curious property recently brought to light; and it is a property which if duly investigated, will be of considerable importance, not only as a means of detecting fraud, but as a useful means of turning to account waste silk, floss, pierced cocoons, &c., &c.

In Kashmír it is said that paper is made, called "reshamī kāgaz," or "haridī kāgaz," from the refuse and pierced cocoons unfit for reeling. The following on the subject of silk solvents is an extract from the Athenæum of January 17th, 1868.

"Silk has been experimented on by chemists, and M. PERSOZ finds that a preparation of chloride of zinc will dissolve silk, which fact at once suggests a method for detecting the tricks of trade practised by silkweavers. Much of the woven silk, so called, sold by mercers and others, contains a large proportion of wool or cotton, sometimes both; but now all may be discovered by an easy chemical process. As above stated, the chloride dissolves the silk, but leaves untouched the wool and cotton; the wool in turn is dissolved by an aqueous solution of caustic potash, which leaves the cotton uninjured. M. OZANAM, in a recent communication to the Academy of Sciences at Paris, carries the question a step further by showing that the several operations may be accomplished

in one single bath of ammoniuret of copper. Let the piece of cloth be plunged into this, and in a short time the cotton disappears; at the end of three, six or twelve hours, according to the strength of the bath, the silk is dissolved, leaving the wool intact. Thus the quality and proportions of the materials of the warp and weft may be easily determined. M. OZANAM explains that, by Mr. GRAHAM'S method of dialysis, it is possible with this bath to separate silk in the gelatinous form, taking care to use for the porous septum a substance that does not dissolve in the ammoniuret of copper. Parchment or paper would soon disappear. Having prepared a quantity of silk in the gelatinous state, as, in fact, it exists in the worm, it might then be possible to draw it out in threads of any length and of any thickness, and thus avoid the trouble of spinning by a process similar to wire drawing. Or silk cloth might be produced, either by a process of pouring out and rolling, or in endless lengths, after the manner of papermakers. And with this capability of reduction to the gelatinous condition, we have the means for reconverting old waste silk, woven or twisted, refuse cocoons and floss, to a useful and valuable article of commerce. These are a few hasty suggestions as to the way in which these interesting chemical results may be utilized; that many others will shortly be forthcoming is not to be doubted."

When silk is reeled, the thread as it is wound from the cocoon being twisted to give it strength, is called "singles;" two or more singles twisted together form "tram," weaving thread, short or weft. When two or more singles are twisted together in a twist of a direction contrary to that of the twist of the "singles," they form which is called organzine, and the art of performing this operation, is difficult and was unknown, in England, according to the Italian method till the establishment of the mills at Derby in 1719. The operation is called "throwing."

The following are the most noteworthy specimens of Punjab silks, connected with the names of which will be found various particulars of the local manufacture and trade.

677.—[]. Raw silk in skeins.
Amritsar. Amritsar. LAHORE MU-
SEUM.

"I have annexed a copy of the reports received by MR. COPE from Manchester,* through the Private Secretary to his Excellency the Viceroy, upon the silk which he last year raised at Amritsar. The

* Extract from a letter from the Financial Commissioner to Government, 30th May, 1862.

report in question is eminently favorable, and MR. COPE considers the entire experiment of last year to have been completely successful, though on a very limited scale. This year he has been unsuccessful, owing he considers to the defective character of the accommodation supplied to his worms. But the success of last year, the continued success of the Kashmiri JAFIR, at no great distance from Amritsar, and his own experience gained during a series of experiments extending through the past ten years, have satisfied him that if all necessary appliances be provided, there is nothing in the climate of this part of the Punjab to prevent the profitable rearing of silk worms.

"The produce by JAFIR this year (of which a specimen accompanies this) is valued on the spot at 16 or 17 Rs. per seer of 98 tolas, while MR. COPE's has been valued at 25 shillings per lb., or 25 Rs. per seer in England, which shows how great a difference in value results from superior reeling. The quality appear to be quite equal to that imported from the westward, and the main difficulty which JAFIR has experienced is in preserving the eggs for which a cool temperature is indispensable. This object he secures by keeping them in a very deep taikhana, or underground room, at Majithia of Amritsar, while MR. COPE purposes attaining the same end by sending them up to Dhurmsala. In the hope of operations being undertaken at Amritsar next season he has secured from JAFIR 10 seers of eggs at 20 Rs. per seer.

678.—[5575-5594]. Series of colored silks. Bukhára. LOCAL EXHIBITION COMMITTEE.

Rose colored.
Blue green (sazb).
Pink (gulábf).
White.
Orange.
Yellow, "mústá."
Scarlet.
Sosani (lilac).
"Kasni gulábf," pale lilac.
"Piázi," pale pink.
"Tori píla."
Pale green.
Grape colored, (angúri).
"Pistáki" (color of pistachio-nut, bright light green).
Pea green.
"Zamráti," emerald color silk.

679.—[5614]. Silk cocoons, reared at Kapúrthalla. REV. J. LAHORE MUSEUM. S. WOODSIDE.

680.—[5615]. Silk cocoons, from Oudh. DR. BONAVIA.

681.—[5616]. Do., Faizábád, Oudh. S. CARNEGIE, Esq.

682.—[5617-18] Cocoons from Kashmir.

683.—[5619]. Cocoons reared at Lahore. NAZIR KHAIRULLAH KHAN.

684.—[5620]. Yellow silk, and white do. (inferior), produced by NAZIR KHAIRULLAH KHAN.

685.—[5622]. Silk worms' eggs. CHAUDRI IMAM BAKSH.

686.—[5623]. Raw silk. Bijnour. REV. T. T. S. HAUSER.

687.—[5627-28]. Samples of silk, from Kangra.

688.—[] Series of skeins (floss silk) from Bukhára but dyed at Lahore. White, black, green, crimson, orange, scarlet, blue, yellow. LAHORE MUSEUM.

The country bordering on the river Oxus and the canals and water-courses from Samarkand and Shah-i-sabz, is full of mulberry trees, on the leaves of which silkworms are fed. About ten days or a fortnight after the mulberry trees put forth their leaves, the eggs of the silkworms are removed from the place where they had been preserved during the winter, and being wrapped in a cloth, are carried against the naked breast, or still oftener under the arm-pit. Three to five days are quite sufficient for the little insects to be hatched. They are then placed in a vessel and fed with the leaves gathered from the mulberry; after ten days the worms, according to the expression of the Bukhárians, fall into their sleep or trance, they take no nourishment three days running, repeating the same process every ten days, until the time they begin to spin the cocoon. When these are finished, the worm inside is destroyed by exposing the cocoon to the heat of the sun. That done, the Bukhárians proceed to reel off the silk threads. The quality of Bukhára silk is much inferior to that of China, and even to the French and Lombard silks, both in color and softness.*

The silk annually produced in the Bukhára ter-

ritory is estimated to be worth 15 lacs. The greatest quantity is exported to India. There are several descriptions of silk.

1. Lab-i-abí, produced in banks of rivers and canals.

2. Vardánzai, produced in the district of that name to north-west of Bukhárá.

3. Chillá jaidar, produced in the environs of Bukhárá—this is the best.

In the description of articles found in the bazars of Kábul by the mission in 1833, we find the following account of Bukhárá silk as imported into Kábul. Raw silk chiefly of the fertile districts of Bukhárá, Kohkán, and Kondaz, is imported to the extent of about 4 lacs of rupees; about 200 camel loads of silk, each containing at an average 26 seers of Kábul, arrive annually at this great commercial mart from different parts. In its original state it is usually of a gray-yellowish color, and is sold at from 90 to 100 Rs. per seer, or 16½ lbs. English. It is here sorted into different kinds, dyed of various colors, and woven into "shúja kháni," "kánávaiz," and other plain silk fabrics. It passes in transit to India and the Punjab. It is imported also from Herát, Mashhad, Shahr-i-sabz, Yarkand, Khulm, and Mazár, and is reared at Kábul in small quantities. It is generally of six different sorts. "Imámi," "kundózi," "charkhi," "lab-i-abí," "shahr-i-sabzi," and "kokhání."

689.—[5549-50]. Silk from Núrpúr, Kangra. (two samples). LOCAL COMMITTEE.

690.—[5633]. Silk. LOCAL EXHIBITION COMMITTEE. Gujranwalla.

691.—[5640]. Cocoons reared at Gujrat. LOCAL EXHIBITION COMMITTEE. Gujrat.

692.—[5641]. Silk reeled, from do.

In April 1863, a few chittacks of silk worms' eggs were supplied to the Deputy Commissioner of Gujrat. The ordinary precautions only were taken in securing the hatching of these eggs. The worms were placed in an empty house in the town, and were fed with the leaves of the native mulberry tree, which is grown to some extent in the neighbourhood of Gujrat.*

693.—[5657]. Silk. LOCAL EXHIBITION COMMITTEE. Dera Ismail Khan.

694.—[5664]. Silk, from Bukhárá. Peshawur. LOCAL COMMITTEE.

695.—[5665]. Series of silks dyed at Peshawur, the silk being the produce of Bukhárá.

696.—[5666-68]. Silk from Akcha, in Balkh.

[5001] Lab-i-ábí silk, from Bukhárá.

[5002] Charkhi silk, from Bukhárá.

[5003] Kokhání silk, Kokhán.

The silks of Bukhárá and Kandahár are imported either *via* Shikárpúr, through the Bolan and other western passes, or else to Peshawur by the Khaibar and other northern passes.

The following are the descriptions of the raw silk with the prices of each in the Shikárpúr bazar, import duty paid (at Rs. 1-6-0 per maund):—

1. Kokání, from Bukhárá (produced in Türkistán), price at Shikárpúr, Rs. 10 per assár.*

2. Tání, from Herát; price Rs. 13-12-0 per assár.

3. Shál-báfi, from Herát; price Rs. 15-10-0 per assár.

4. Nawábí, from Bukhárá; price Rs. 14-12-0 per assár.

5. Gheilání, from Kirmare and Yazd; price Rs. 9-0-0 per assár.

6. Kaláchir, from Herát; price Rs. 9 per assár.

The value of annual imports may be about Rs. 50,000, and the route is through the great pass of the Bolan.

A quantity of Kábul and Bukhárá silk is also imported into Máltán and other places, to meet the demands of the great silk factories. The following account of silk at Máltán has been communicated by LIEUT. CORBYN, Assistant Commissioner.

It has been ascertained from the best and most reliable sources that about 300 packages of 1st, 2nd, and 3rd quality raw silk, weighing in all 750 maunds, the price of which averages to Rs. 3,75,000, are imported annually into Máltán from Kábul, Bukhárá, Khorásán and Herát. Of this, 225 maunds, valuing Rs. 1,12,500, are exported to the following places, viz., Baháwalpúr, Karáchi, Bombay, Dera Gházi Khán, Shikárpúr, Sakkar, Haidarabad, Súratbandar, Delhi, Farrakkabad, Bikanir, Sir-

* Silk, raw and prepared, is weighed at the rate of 90½ Shikárpúr Rs. to 1 assár; 90½ Shikárpúr Rs. equal in weight 88½ new Company's. The present exchange between the two currencies is 94½ Company's per 100 Shikárpúr, or 5½ per cent. in favor of the former. Nos. 1, 2, 5, and 6 of the raw silks, above enumerated, are prepared for weaving, and dyed at Shikárpúr; the Shál-bafee and Nawábí (Nos. 3 and 4) are manufactured at Rori, on the opposite bank of the Indus, into a coarse silk fabric, known as daryal.—LIEUT. POSTAN'S Memo.

* LOCAL EXHIBITION COMMITTEE, Gujrat.

sa, Ajmír, Benares, Lahore and Amritsar, &c.; 225 maunds of cleaned silk, after being dyed various colors, valuing Rs. 1,12,500, are also exported to Jhung, Karáchi, Pindibhattian, Chiniot, Bunnoo, Dera Gházi Khán, Dera Ismail Khán, Leia, and Sakkar.

The remaining 300 maunds of silk, priced at Rs. 1,50,000, after undergoing the process of cleaning, are applied in the manufacture of the following description of fabrics, viz., dopatta, daryai, gulbadan, súsi, mashru, and lungbi, which are partly used here and partly exported to Shikárpúr, Haidarabad, Sakkar, Karáchi, Dera Gházi Khán, Dera Ismail Khán, Leia, Jhung, Chiniot, Kamáliya, Lahore, and Amritsar.

The following is an account of the approximate cost of dyeing :—

Kirmji, or crimson,	2 Rs. per every seer of silk.
Sabz, or green,	1 " "
Siyah, or black,	1 " "
Zard, or yellow,	1 " "
Gul-i-ánár (i. e. scarlet),	8 Rs. "
Safed, or white,	6 Rs.

697.—[]. Cocoons reared at Peshawur, with the silk reeled from them. LAHORE MUSEUM.

The following is derived from MR. SCARLETT's account of the rearing of silk at Peshawur, dated 11th July, 1863.

The stock of eggs to experiment with was as follows :—

35 tolas from Jalálábád, procured through MUHAMMAD AZIM, Paracha.

16 tolas from Bukhára, through JAN MUHAMMAD.

14 tolas, acclimated (from last year's out-turn).

120 tolas, procured through LIEUTENANT POWLETT from JAFIR ALI, making a total of a little more than 4½ lbs.

Three parts of the district were selected for the experiments, Peshawur itself; (2) the village of Khazána in the Dá'údai pergunah, the locality of previous experiments; and (3) Charsadda, beyond the Kabul river, in the Hastnaggar tahsil.

The Charadda branch, though personally supervised by MUHAMMAD KHAN, failed altogether. The eggs are said not to have hatched at all; part of them had been procured from Bukhára and part produced at Peshawur. The cause of the failure has not been explained. I attribute it to some mismanagement of the eggs, for as regards climate, Charsadda varies little from Peshawur.

The Jalálábád eggs were tried at Khazána. MUHAMMAD KHAN's family, accustomed to be employed in

this way for the past two years, undertook the management, and were successful. The only accommodation the worms had was a primitive guest house, or hujra.

The Peshawur silkery comprised the produce of the 120 tolas of eggs got from JAFIR ALI. JAN, a silk grower in former times, was immediately in charge. The rooms over the eastern gateway of the Gorkhatri afforded ample and suitable accommodation.

No artificial means were employed to assist the process of hatching. The eggs were kept in an open basket on the sunny side of the room, average temperature 76°. I have had reason to regret the omission of artificial aids. The hatching was irregular, and 24 tolas of the eggs showed no signs of vitality; moreover, the latter worms were inferior, and produced bad cocoons.

The worms appeared simultaneously with the mulberry leaves (7th March). They were removed daily into large wooden trays placed on the floor. For the first few days the tender leaves carefully stripped from their branches, were supplied; but as the worms grew stronger, the branches themselves were strewn over them.

The consumption of leaves rose from two to fifty loads a day. According to experiments made in France, every ounce of eggs requires 20 quintals of leaves. The Peshawur worms must at this rate, have devoured 85,120 or 212 lbs., for every ounce of silk they subsequently produced. There was some trouble and a good deal of expense in collecting that supply. The zemindars objected to the use of their plantations, and justly so. The mulberry is, with rare exceptions, the only tree that grows abundantly about their fields, and affords them shelter during the summer months. Our supplies had therefore to be drawn from trees growing along roads or on Government lands.

Three kinds of mulberry flourish in the valley. The white variety (*Morus alba*) is the most common, and was principally used. In an experiment conducted by LIEUTENANT HUDDLESTON, lettuce was substituted for a time, and as far as I can judge, with no inferior results. He had procured some eggs for a friend; they were forgotten on the mantle piece. The next intimation of their existence was conveyed by the worms themselves. They were prematurely hatched owing to the heat of the chimney; and in the absence of mulberry leaves, had to be fed on lettuce. The natives, however, look on the mulberry leaf as the only natural aliment of the worm, and this view is confirmed by the experiments instituted in different parts of Europe.

The average period of the worm's existence anterior to the production of the cocoon, proved to be fifty days. There were the usual intervals of sickness

during which the worm declined all nourishment. As soon however as it cast its skin, its activity or rather appetite returned.

About the fifty-first day it gave up eating altogether, and moved about seeking a quiet corner wherein to undergo its impending transformation. The time for spinning had now arrived. Light bundles of brushwood were arranged along the trays and were soon covered over with cocoons in their various stages of development.

Forty-eight hours appeared to be the average time occupied in the formation of the cocoon. The worm though no longer visible to the eye, is known to exist by the noise produced by its labors. As soon as this noise ceases, the cocoons are gathered.

On the whole the worms were as healthy as could be expected. Here and there some assumed the jaundiced appearance unmistakably indicative of disease; these were at once removed to avoid contagion.

All diseases are ascribed to either—first, the use of damp floors or leaves, electrical state of the atmosphere, overcrowding, want of ventilation, insufficiency of nourishment; and these ascriptions have been corroborated by European experience; secondly, the presence of evil spirits and of unclean persons. I need hardly add that these subtle enemies of the worm have as yet evaded the closest European scrutiny.

It is a lamentable fact that the diseased worm cannot be doctored, so in the absence of means of cure certain preventives are adopted, such as ventilation, cleanliness, fumigation. The first two call for no particular remark. The third is a simple process. Earthen stoves lighted in different parts of the silkery are occasionally sprinkled over with "ispan" (Persian), a grain to which native superstition ascribes the virtue of searing evil spirits.* I am at present unable to say whether it possesses any value as a disinfectant.

Disease however is not the only enemy of the worm. Rats, mice, and birds have to be equally guarded against. The Khazána silkery suffered considerably from their depredations, as the accommodation was not such as to afford immunity from their attacks.

The cocoons varied in size and color. The largest weighed, deducting floss silk and worm, about 5 grains, the smallest scarcely a grain; most were of a light yellow color, while the rest were either straw-colored or white. The first are said to yield the finest silk.

The out-turn was separated into two parts. About 12 seers were deposited in a cool place. The chrysalis continued dormant nearly a week, after which the full grown moth forced its way out. The process of regeneration occupied two days, resulting in 115 tolas of eggs; each female moth contributed on an average 250 eggs, weighing nearly 11 grains.

No attempt was made to keep the female moths separate from each other during the time of laying, or subsequently to select from the eggs produced; but these points are of considerable importance, and as sericulture extends in the valley, the establishment of a shed for the re-production of healthy eggs will become very desirable. Nine-tenths of the diseases that decimate silk worms, are no doubt inherent in the eggs themselves.

The second batch of cocoons intended to be reeled, needed different treatment. It involved the ungrateful task of destroying the worm. It has just been remarked that the moth forces its way out of the cocoon; and although in doing so it does not break the filaments, but simply pushes them aside, the puncture is fatal to the reeling process. The cocoon gets filled with water and sinks to the bottom of the basin, thus rendering the unwinding impracticable.

To avoid this, the cocoons were exposed to the sun for a few hours on three days, consecutively. This treatment generally suffices; but to make certain some of the cocoons were ripped up, and the chrysalis was pricked. There was no sign of animation, otherwise a longer exposure had been necessary.

The next operation was the removal of the floss-silk, or the white filaments enveloping the cocoon. This was easily done with the hands. The cocoons were now ready for reeling.

A cocoon may be unwound with the hand. The filament is found to be continuous, and in the largest cocoon, measures nearly a thousand yards; but as it is too fine to be of any use singly, and mere hand-labor would be too tedious and expensive, the aid of machinery has to be supplied. In Europe there are various contrivances more or less complicated. The simple method adopted here is almost identical with what prevails all over Central Asia.

The cocoons are thrown into the basin, which is previously filled with water and heated. A few minutes immersion suffices to dissolve enough of the gum to loosen the filament. The mass is now beaten up with a switch, to which the disentangled ends of the silk readily adhere. These ends having been drawn up are put together in numbers proportioned to the thickness of thread required, and are then passed on to the reeling machine, in which the thread first passes through a narrow eye or loop, over a pulley, and then is fixed to the reeling bobbin. The loop or eye pre-

* Ispan or "harmal," *peganum harmala*; the wild rue of botanists, abundant on waste ground in the Punjab.



vents impurities passing on and reduces the proportion of gum in the thread. The average number of filaments composing the Peshawur thread (double) is eighty.

Two men are required to conduct the operation. While one forms and watches the thread, the other reels it on the bobbin. About a pound of silk may be reeled per diem.

The arrangement is, however, defective in a material point. It fails to produce sufficient evenness in the thread.

The total quantity of silk produced was 25 lbs. In addition to this there were

10 lbs. of "surnukh," or coarse ends.

8 „ of punctured cocoons.

52 „ of refuse (floss-silk, &c.)

The following calculation will show the relative proportions of the constituent parts of the cocoon:—

	lbs.	oz.
1,000 cocoons, weighed,	1	0
Deduct floss-silk and impurities } adhering thereto.	0	6
Worm and glutinous matter, ..	0	8
Balance, or silk,	0	2

The average quantity of silk produce from each cocoon is two grains.

It will be interesting to compare the silk produce here with that imported from Central Asia as regards market value. This article is not imported from Kashmir, and the European produce is too superior to admit of any comparison.

Price per Peshawur
seer of 104 tolas.

No. I., Peshawur, 16 Rs.

No. II., from Vardanzai, 17 „

This is the best silk procurable at Peshawur. Its superiority consists in the fineness and evenness of its thread. Vardanzai is one of the seven "tomans," or perganahs of Bukhara, situated about 35 miles north west of the capital on the caravan route to Orenburg or Troitska.

No. III., from Akcha, in the province }
of Balkh, 16 Rs.

No. IV., Lab-i-abi, corruptly called }
Nababi, from Bukhara, 14 „

Burnes' in his papers on the kingdom of Bukhara remarks with reference to this silk:—

"The most valuable insect is the silk-worm, which is reared in all parts of the kingdom where there is water. Every stream or rivulet is lined with the mulberry, and the most extensive operations are carried on along the banks of the Oxus, where the whole of the wandering tribes are engaged in rearing the insect. The silk of the Lab-i-abi or banks of the

river, as it is termed, is the most valuable, both from the softness and fineness of its thread.

The Lab-i-abi districts extend along the Oxus and are called

1. Narazi, ... | 3. Charjai,
2. Kahi, ... | 4. Utir.

No. V., from Khulm, called charkhi, 13 Rs.

No. VI., from Kokand, 10 „

Pursuant to this experiment, a meeting of the principal members of the commercial community was called, and the whole subject was discussed. All present agreed in the desirableness of extending operations, and in the necessity for exertions on the part of the people themselves. It was resolved that a commercial company should be formed. A paper embodying the following propositions was thereupon drawn up and signed:—

I. That a company be formed, consisting of twenty shareholders paying Rs. 50 each.

II. That members possessing land cultivate as many acres as they can spare, with the mulberry, on the condition of being remunerated.

III. That the Puracha members arrange to procure a supply of eggs from Bukhara and elsewhere.

IV. That three or four families of silk rearers be invited over from the nearest silk growing districts, and encouraged to settle at Peshawur.

Active measures are on foot to ensure the success of this object.

The supply of eggs for the ensuing season will probable be:—

115 tolas acclimated at Peshawur.

160 from JAFIR ALI.

360 from Bukhara.

635 tolas, or nearly 16 lbs.

The silkeries are intended to be as numerous and as widely scattered over the district, as the agency at command shall admit of.

About 32 acres of fresh land are being planted with the mulberry. It was intended to introduce the large leaved species (*Morus multicaulis*), but the latest trials in Italy have shown that it is not suited for the silk worm.

An invitation has been sent to some families of silk rearers to immigrate from Kujja, a district in the vicinity of Jalalabad. I am assured there will be no difficulty in effecting this.

The families thus obtained, with those already in the valley, will afford all the necessary subordinate agency, while the members of the company now formed, will undertake the direction and supervision.

It will be interesting before closing this notice of the Peshawur samples to give the results of a microscopical examination, showing the breadths of the

filaments of these and other silks.* DR. BROWN writes, "I have examined microscopically the specimens of silk sent by you, and that I find the diameter of the threads varies considerably in different specimens."

"In No. 1, the diameter was $\frac{38}{1000}$ of an inch; No. 2, $\frac{14}{1000}$ of an inch; No. 3, $\frac{28}{1000}$ of an inch; No. 4, $\frac{9}{1000}$ of an inch; No. 5, $\frac{25}{1000}$ of an inch; No. 6, $\frac{25}{1000}$ of an inch. Subsequently, I examined two specimens of silk brought by H. COPE, Esq., and stated to have been prepared by a native named JAFIR: I found them rather irregular in the diameter of the thread, but the average breadth was $\frac{19}{1000}$ of an inch."

698.—[]. Cocoons, reared by
 Gurdaspur. JAFIR ALI.

699.—[]. Series of Raw silk,
 reeled by JAFIR ALI.

The following is extracted from MR. POWLETT'S account of the Gurdaspur Sericulture.

On my way to Durreah Pattan, I ascertained that considerable interest is felt by the neighbourhood in JAFIR'S proceedings, increased no doubt by the jealousy he displays lest any one unconnected with himself should attempt silk cultivation, which he would fain keep as a monopoly in his own family. I was told that many would be glad of eggs, but JAFIR had refused to part with any; and indeed, would allow no one near his worms, not even his own son. His objection to allow any one to approach the worms does not arise so much from jealousy as from a superstitious fear of the evil eye, to which fatal sickness among silk worms is I believe attributed all over Asia.† JAFIR told me that English gentlemen were alone permitted to see them.

On my reaching to Durreah Pattan, the first thing JAFIR insisted on showing me was the medal obtained for him by MR. COPE, from the Agri-Horticultural Society. He carries it about with him and seems not a little proud of it. He told me that he had been established at Durreah Pattan some 20 years, and that he originally learnt silk rearing at Peshawur, where formerly valuable silk was raised: there were two establishments for the purpose when he was there.

* The measurements are obtained from the Report by Dr. T. B. B. BROWN, Chemical Examiner for the Punjab, in his letter to the Financial Commissioner, dated 15th August, 1863.

† The same prejudice exists on the part of the men (usually of the bearer or kahar caste) who tend the tasar or wild silk. From the time when the worms are hatched and placed upon the trees in the forest which they have previously prepared for their reception, they will watch carefully that nothing from without may come near them. Keeping themselves at the same time most punctiliously apart from all that might render them ceremonially impure.

I particularly questioned him regarding his stock of eggs, and the measures he adopted for preserving them during the heat, as I was anxious to ascertain whether there was any trace of deterioration in the worms from plain raised eggs, or whether renewal from the hills was beneficial. He assured me that so far from deteriorating, acclimatised eggs were far better than hill raised, as the latter produced in the plains sickly worms, many of which died in skin casting; on his commencing business he found it necessary to procure eggs from Peshawur as the Kashmir stock he had was unprofitable, and ever since, that is for 20 years and upwards, he has raised his own eggs, keeping them during the hot weather in a taikhána at Ma-jeetha in the Amritsar district. This method of preserving them is not however satisfactory, as from a fourth to a third is always destroyed by the heat. JAFIR showed me a quantity so destroyed, for the most part the heat had dried up the eggs without hatching the worms. Those that survive the heat are not injured but produce as healthy and fine worms as if the eggs has been kept in a cool climate; this the state of JAFIR'S own worms clearly demonstrated, but it would undoubtedly be a great advantage to establish (when silk cultivation has extended itself) a depôt on the hills where eggs may be kept during the hot weather. The carriage backwards and forwards would probably not cost 2 annas a seer, whereas the loss by keeping them in taikhánahs in the plains is (reckoning their value at Rs. 16 a seer) 4 or 5 Rs. a seer; out of taikhánahs the eggs cannot be preserved in the plains at all.

None of JAFIR'S worms had commenced spinning when I saw them (April 7th): they were of various ages, some would begin spinning in four days, some in six, some not for ten or twelve or even fifteen days; these last three sets were not of much value.

As I was under the impression that the silk worm was very delicate, I was much surprised to find JAFIR'S, though under such poor shelter and so crowded, looking so fine and well. Two old pauls and five or six sheds both very low, and the latter ill-ventilated, contain the whole of his stock. A hovel 30 feet by 16 feet scarcely high enough to allow a man to stand upright held sufficient to produce three seers of silk: there was nothing to keep them off the ground beyond the accumulation of mulberry branches, which were removed but once in ten days. They occupied the whole ground of the shed, with exception of a passage $1\frac{1}{2}$ feet wide down the centre. In the pauls the worms lay as thick as in the sheds, there was nothing beyond a single fly to keep out the rays of the sun, for such trees as were near the pauls gave little shade.

In answer to my queries about the value of the

silk he produced, JAFIR told me that last year he sold it at Rs. 15-8 a seer, and this seemed the average rate. As I happened to have made notes of the value at Peshawur, of different descriptions of imported silk, I can assert that the above is a higher price than is there obtained for the common Kokan, Bokhara, and Khulm silk, and within a few annas of the value of that called Lab-i-abi, which is raised on the banks of the Oxus, where the best Central Asian silk is I believe produced. JAFIR himself admitted that his profits were amply remunerative, and the impression in the vicinity is that he is wealthy, and that too in the face of the considerable disadvantages.

JAFIR informed me that a seer of good seed (eggs) should produce 21 seers of silk, or if the silk is sacrificed, the same weight of eggs; for it is said that the amount of seed produced by a given number of worms is equal to the amount of the silk which would be yielded by an equal number, and this the price of seed (16 rupees a seer) in Kashmir bears out. The amount of silk that a certain number of cocoons will yield varies very much; JAFIR told me he had sometimes got two seers of silk out of one seer of dried cocoons, but sometimes not even one seer: the best cocoons should yield one seer for five. He knew nothing of cross breeding, never having tried it. He raises silk but once a year, I believe it is possible to have a second crop; but JAFIR said that it could never pay as the leaves lose the nourishing properties in the heat of summer: he seemed to think too, that young tender leaves were necessary for the young worms. I should think JAFIR was right on this point with reference to silk culture in the dry plains, though in the hills it may be different. He feeds his worms morning and evening. The leaves should be as fresh as possible; but are dangerous if given wet.

JAFIR winds his own silk; he said that he could wind four seers a month, working up to 12 o'clock in the day, which over a fire in the hot weather is as much as he can comfortably manage. If hard put to it, he could wind six seers a month. When winding, three assistants are necessary to keep up the fire, &c. The dry branches of the mulberries from which the leaves have been stripped, are sufficient to keep the pot that holds the cocoons boiling, so he is put to no further expense for fire-wood. The cocoons from which moths have been produced are worth 2 Rs. a seer, being many times lighter than cocoons containing the chrysalis. The latter cocoons when dried vary in value from 8 annas to 1 rupee a seer.

More recently various relatives of JAFIR have taken to growing silk, and the following extract from a letter read to the Agri-Hor. Society of the Punjab in July 1863, will show how they succeeded.

One of the persons alluded to is named SUBHAN; he is the son-in-law of JAFIR, and learned the art of reeling silk from his wife, who has learned it from her father. The experiment described was made in 1863.

"SUBHAN had half a seer of eggs of his own, and bought another half seer at Sajánpúr. He hired the ante-room of a Hindoo temple for Rs. 5, and has, notwithstanding the losses he incurred, obtained cocoons enough to reel between 13 and 14 seers of silk. The following is a statement of the financial result of his operations, which shows that silk rearing is profitable even on this small scale. It is beyond a doubt that silk rearing would extend rapidly amongst the Mahomedan population in the neighbourhood of Nainakote, Nerote, &c., if the cultivation of mulberry trees were largely encouraged in the pergunah:—

"Cost of one seer silk worms' eggs,	Rs.	11	0	0
" of mulberry leaves,	"	10	0	0
Paid coolies for gathering and bringing in,	"	25	0	0
House-rent,	"	5	0	0
Own wages, calculated at 5 Rs. for 5 months, for tending worms and reeling,	"	25	0	0
Wages of an assistant, at Rs. 2-8,	"	12	8	0
Cleaning silk at 12 As. per seer,	"	10	8	0
Interest on money borrowed, ...	"	0	3	0
Total Rs., 102 0 0				
Nett proceeds of 14 seers of silk, at Rs. 16-8 per seer,	"	204	8	0
Leaving a nett profit on the season's operation of,	"	102	8	0

or more than 108 per cent. per annum.

"JAFIR tells me that he will turn out about 35 seers of silk and eggs, which at the same rate will have yielded him a profit of Rs. 270.

"There is no reason for believing that SUBHAN has understated his expenditure (the tendency would be the other way) and I know that the silk realized the rate he mentioned.

"Besides the silk reeled there are about 2 Rs. worth of cheshum (refuse), and he has one seer of eggs for next season.

"I collected materials in 1862, from which I estimated, on fair grounds, the total out-turn of silk in zillah Gúrdaspúr at, if I recollect right, 56 Lahori seers, equal to nearly 140 pounds, valued at about 850 Rs.

"I have now ascertained that the out-turn of this year has been about 80 Lahori seers, or about 195 lbs., produced in the following proportions:—

JAFIR ALI of Dereea,	34	seers.
ROMANA, his son,	9	"
ALLADITTA, his brother-in-law,	4	"

HATA, another brother-in-law,	4 seers.
SUBHAN, his son-in-law,	13 "
MUSTAN SHAH, of Sajānpūr,	14 "
Total,	78 "

"Besides, they have amongst them about 10 seers of eggs for next year's operation; the value of this year's silk is about Rs. 1,380, showing an improvement in money value of about Rs. 500, and an increase in quantity of 35 lbs. JAFIR has obtained a grant of 10 ghumaos of land in the Shakarghar pergunah, from an over large encamping ground, and has applied to me for cuttings of the Chinese and Philippine Island mulberry plants, which he shall have to the extent of my means."

700.—[5692-99]. Series of skeined and twisted silk, dyed at Kashmir. Srinagar. White, black, Turkis blue, crimson, scarlet, and green of three shades. H. H. THE MAHARAJA.

In Kashmir the houses where the silk worms are kept do not differ from the dwelling places of the inhabitants; indeed, in many instances the raisers and their families live under the same roof with the worms. The single spacious loft which ordinarily constitutes the upper storey of the houses occupied by the lower orders in the valley, is generally the principal breeding room. The silk raisers (called "kirm kash") do not confine themselves to the production of silk, but are either agriculturists or shawl weavers besides. One individual has not usually charge of more worms than are sufficient to produce 30 seers of silk. The eggs begin to hatch about the middle of April, and during the first few weeks of the worm's existence, an untimely fall of snow frequently injures the owner's prospects; this year a fall in May did much mischief. Drought, as it affects the yield of mulberry leaves, is no less baneful. It is satisfactory to know that the interests of the Punjab silk raisers can never suffer from unseasonable cold, and he will thus have an advantage over his brother of Kashmir.

I was informed that for some years past there have been unfavorable seasons in Kashmir, but I could not discover there was any known disease among the worms; undue cold or drought and the difficulty of procuring coolies to collect leaves were the causes assigned. Paucity of laborers is a serious obstacle to silk cultivation in Kashmir; in addition to causing the worms to be insufficiently fed it must occasion a want of proper cleanliness. The importance of this last, however, is not fully appreciated by the raisers.

In the plains the worms exist for 38 or 40 days only before they begin to spin; but in Kashmir, ow-

ing to the comparative coldness of the climate, they live nearly twice as long. This then is a third advantage over Kashmir that the Punjab possesses, for the expense of attendance will of course be in proportion to the length of the worm's life, and I presume the same is true of the quantity of food consumed. Round Srinagar the spinning seemed to be at its height at the beginning of July.

A fourth advantage the Punjab may have will be superior winding (the Peshawur and Bukhara winding even is far better than the Kashmir); and a fifth, and the greatest of all, will be an immunity from an oppressive silk duty, and a harassing interference on the part of the Government.

No particular precautions against cold are necessary for preserving the eggs during the winter; they are usually kept in an earthen vessel, with the mouth of it secured (of course the vessel must not be placed any where near a fire, otherwise the eggs will hatch). I do not speak confidently, but as far as I can make out, excepting that mulberry leaves are procurable free of cost (a boon equivalent to less than half the amount of tax exacted), a greater facility in preserving the eggs is the only decided advantage, which Kashmir, as a silk raising country, has over parts of the Punjab plains; and this is not a considerable one, for eggs will probably be conveyed to and from the hills for less than one per cent. of their value.

I heard of several attempts in Kashmir to raise a second crop of silk during the year, but none had been successful. The failure was attributed to the unfitness of the old mulberry leaf for the young worms. I imagine that the leaf loses its nourishing properties as the season advances.

The male or fruitless mulberry (khassee) is in Kashmir the kind most valued for its leaf; which, as has been remarked by MR. COPE, is due to the leaf's obtaining the share of nourishment which in other varieties is diverted to the fruit. The leaves of the "Shah tut" (not the Punjabi "Shah tut," but the large crimson fruitbearing English mulberry) are said to be bitter, and almost useless for silk worms, though many of us in our younger days have fed a few upon them. The other three kinds (the small black, white and purple, fruit, bearing "Siyah tut," "Chitta tut," and "Bara tut.") are all equally valuable I believe, but inferior to "khassee." In Kotihar, the south eastern part of the valley, I saw a plantation of grafted purple mulberries, the leaves of which were very fine. It had originally been planted for fruit, there was no lack of trees for leaves in the neighbourhood, but the owner told me that he found silk worms benefitted much by a few feeds from these grafted trees just before spinning. When the worms are young he thought these leaves would be too strong



ary from Amritsar, and on the 1st of March, 15
tolahs more came from Peshawur, which were hatched
in successive portions artificially; up to March 12th
the hatching was effected as usual by putting the eggs
in a flannel bag and getting a man to carry them close
to his chest for about 70 hours. Putting the eggs
below a hen might succeed.

On the 22nd March, the worms consumed 6 seers of leaves a day, and one coolie was sufficient to attend on them. On the 24th an extra man had to be entertained. On April 6th, five men had hard work to bring enough leaves; and before the first cocoon was commenced on April 12th, nine men were employed. On the 17th April most of the worms were ready to spin, or had completed their cocoons, and by the 1st May, there were 78 lbs. of dried cocoons and 10 lbs. not dried, but kept to give eggs. The greatest space occupied by the worms was 800 square feet, but they were crowded.

Two weavers were sent to Gujranwalla to learn to reel, they returned and commenced operations in June. At first they made very coarse silk, but the last seer reeled fetched 18 Rs. at Multan. The following is a statement of the actual cost of the experiment.

Cost of 17 tolahs of eggs,	5	0	0
Coolies for collecting leaves and attending the worms, at 5 Rs. per mensem,	39	0	0
Leaves purchased,	9	0	0
Two weavers sent for a month to Gujranwalla,	12	0	0
Iron pan used in reeling,	5	0	0
Reeling apparatus,	1	8	0
Cost of reeling, being the wages of two reelers, at Rs. 6 a month, ...	25	0	0

The proceeds of the experiment were—

16 lbs. of reeled silk, sold at Múltán,	117	0	0
35 tolahs of eggs, valued at	...	8	0
Value of iron pan and reel,	...	4	12

Total Rs., 129 12 0

The actual profit was Rs. 33-4, but had there been no need of purchasing reeling apparatus and leaves, then Rs. 40-8 might be deducted, being a nett cost of Rs. 56, and a profit of Rs. 73-12.

These 35 tolahs of eggs obtained were divided into three portions: one was sent up to Sakesar, 5000 feet; one was sent to a lower locality, called Sodhi valley; and the third was put in an earthen jar, covered with paper, and kept in a bath-room at Shahpūr; the two former portions were spoiled during the rains, but the third portion being kept in the cool-

Two tolahs of eggs were obtained on 10th Febru-

est part of the house, were found in February 1865 to be in good condition, and are now being reared at Saliwāl.*

The climate of the Salt range is much milder than that of the plains, and wild mulberry trees are abundant; also there is a wild species of silk worm indigenous, which feeds on the camel thorn (*Alhagi maurorum*).

The following observations on the silk at Shahpūr may be found interesting. About one-fourth of the worms were black, and all the rest white. Three days before commencing to spin, the average length of each worm was 3 inches. One hundred of the largest black worms then weighed 8 ounces and 360 grains, or about 42 grains each: the cocoons they produced weighed 6 ounces, and 220 grains, and these yielded 30 grains less than an ounce of eggs.

One hundred of the largest white worms selected at the same time, weighed 10 ounces and 420 grains, or about 52 grains each. They gave of cocoons 7 oz. and 220 grains, and gave 1 ounce and 70 grains of eggs. 4 lbs. of the best cocoons produced by black worms, gave 250 grains less than 7 ounces of eggs; 4 lbs. of white worm's cocoons give 160 grains less than 11 oz. of eggs; 18 lbs. of average cocoons yield nearly 4½ lbs. reeled silk.

702.—[] Silk, from Gugaira.
MR. PEAKE.

The following is an account of the experiment at this station in 1863:—

Five tolahs of eggs were received from Peshawur in a closed tin case. The box was opened about the 8th of March, and the hatching was found to have commenced. The young worms were first fed on tender leaves, and then gradually as they grew in size and strength, allowed small sprigs and larger branches.

Two rooms were used, one 10 × 14 × 11 feet in size, the windows were allowed to be kept open till the second week in April when they were closed during the heat of the day. Charpoys were employed to form terraces or shelves upon; they were placed in an inclined position. Across these beds strings were carried 2 feet apart, and the same distance above the bed, the stems of the branches rested on the beds and the tops on the cross strings.

The advantages of the plan were three-fold. I. The air circulated freely from all sides of the branches. II. The excrements dropped on the bed and rolled down, and were thus easily swept away twice a day. III. The branches were replenished with ease as well

as removed, without disturbing the worms in the least. It was amusing to observe how quickly they moved on to the fresh branches so soon as they were laid on.

The room was on the south-east corner of the house, where light and air could be freely admitted. The temperature averaged about 75, extremes being 62 and 80, degrees.

The second room was on a second floor with a door and two windows; the temperature was two degrees higher, and a greater amount of light and air was available.

The maximum quantity of leaves, I think, never amounted to more than three loads per day for each room. This was supplied from trees growing in gardens and those on the road side.

The mulberry leaves used were of the white kind (*Morus alba*) only. These trees grow very luxuriantly at this station.

The first cocoon appeared on the 35th day, but they began to increase in number perceptibly about the 42nd day, and on the 52nd day they were gathered. The worms appeared healthy throughout the time occupied in the formation of the cocoons.

As soon as the cocoons began to appear, light bundles of brushwood were placed on the four sides of the charpoys, which was quickly occupied; very soon after the worms began to spin, and from forty-six to forty-eight hours the cocoons were quite formed.

Of the remaining one-third of the eggs, the hatching was not attended to for ten days, the eggs being kept in the tin box, yet they succeeded pretty fairly, only a few of the worms having died.

From 2,250 cocoons 35 tolahs of eggs were produced. The total yield of the two places was as follows:—

Rooms.	Eggs.	Cocoons in number.	Cocoons in weight.
	Tolahs.		Tolahs.
I.	9½	3,587	574
II.	3½	6,122	950
Total,	5	9,709	1,524

The various colors of the above bore the following proportions:—

Rooms.	Yellow.	Straw.	White.	Total.
I.	850	550	2,187	3,587
II.	1,701	1,223	3,198	6,122
Total,	2,561	1,773	5,385	9,709

* A native of Saliwāl has planted out several hundreds of mulberry trees along a canal which passes through his fields, and is endeavouring to cultivate silk on a large scale.

MR. COPE pronounced the cocoons very good. I

shall here quote from his letter:—"All I can say of the cocoons is that they are *remarkably fine*, and if you can rear any quantity of the same quality, the credit of Gugaira as a silk-rearing locality would be at a very high figure.

There are about 600 mulberry trees in this station. The area of alluvial land which is available for the cultivation of these trees is extensive, and if the Civil station is eventually removed to Sahiewal, this place would make a capital locality for sericulture, and the abandoned buildings would afford good breeding quarters, and the gardens any amount of leaves. I have ordered a rood or more to be planted with cuttings at every well.

703.—[]. Japanese cocoons. DR. HENDERSON.

These cocoons are from Japan eggs, they are white in color, *very* much smaller than the ordinary cocoons, and are of a peculiar shape, being somewhat depressed in the middle like a figure 8, loosely drawn.

The silk is of excellent quality, but the fact that ought to bring the Japanese worms into notice is, that they will produce cocoons *five times* in the year.

WOOL.*

Scarcely inferior in importance to the silk just noticed, ranks the class of wools. This includes the beautiful pashms of Changthán and Turfán, and the soft white fleeces of Kirmán. This class will be found to embrace three distinct kinds of wool, distinguished not only by the climate and soil where they

are produced, but also by the fact that they are the produce of different animals.

These classes are—1st. The genuine pashms of Changthán, Turfán, &c., which are monopolized by Kashmir;* and those second class pashms, the produce of Rodokh, Ladák, and even Spiti and Rampúr Bashahr, which form the staple export to the shawl manufacturing cities of the Punjab, Amritsar, Ludhiana, Jelálpúr, Nurpúr. Included by analogy of locality only, are the wools of the Ibex, so rarely seen, and the Yák, the thick tails of which animals are prized for chauries (fly flaps).

2nd. The wools produced beyond the N. W. Frontier including those of Peshawur.

In this division comes;—the Dumba sheep wool, the wools of Kábul, Bukhára, and that imported from Kirmán; in fact all classes of wool, produced on or beyond the N. W. Frontier. The trade in these wools is now extensive, both by the Peshawur and other routes in the N. W. Frontier. There is also a very considerable export to Karáchi and Bombay. It is a remark of BURNES, "that our early commercial connection with the countries on the Indus was sought in order to find vent for British woollens, while the existing trade was almost confined to cottons; and this is the more singular as there is good reason to believe that in return for those cottons we shall shortly receive raw wool from the countries of the

* In this country wool deteriorates immediately on commencement of the rainy season, unless very carefully watched. Pashmina and pashmina fabrics are as quickly destroyed and need exposure to the sun and air, whenever during the rainy season an opportunity offers. Samples of raw wool are soon eaten up: the fibre does not disappear, but remains *in situ*, looking of a pale color like an ash till it is touched, when it all collapses into dust. Pashmina is especially liable to this fate; there are several insects which eat the wool, but the most formidable is a blackish apterous insect, about one-fourth of an inch or less in length, of an oval shape, with small head and legs, an oval body divided into segments by abdominal rings, from the edges of each of which strong black hairs project like a fringe. A number of specimens in the Lahore Museum have suffered in this way. The boxes that contained the wools were found on being opened only to contain a little dust like ashes, as if the wool had been burnt, and a quantity of the dead carcasses of the insects, which had eaten it up, and died within the wooden prison, from which they could not escape. I have attempted recently to preserve wool in glass bottles, by treating it first with a solution of corrosive sublimate and camphor, and then drying in the sun.—B. P.

* The interests of the Maharaja of Kashmir and his manufacturers are identified in the endeavour to retain the monopoly of the shawl wool; consequently, none of the Turfáni wool from Yarkand, which is the finest, is allowed to pass into British territory; we are entirely supplied from Changthán.

It is probable that, on the whole, the demand for shawl wool has of late years much increased. Native accounts represent that the use of the Turfáni wool has arisen within the last quarter of a century.

It is evidently of the highest importance that the supply of the raw material of the exquisite shawl manufacture, peculiar to Kashmir and the Punjab, should be effectually facilitated and protected. There is no doubt that it is inexhaustible; and it is impossible not to admire the felicitous conjunction, in the same region, of a natural product so valuable and of workmen so artistic.

Indus." This anticipation has now been completely fulfilled.

The 3rd division includes the produce in wool of the districts of the Punjab. With the single exception of the Merino sheep introduced into Hazara, the wools are almost entirely the produce of the sheep (black and white), or the goat. To these must be added the wool of the camel in the "thal" and "bar," of waste districts such as Shahpūr, Gugaira, and others.

Wool being generally, in the Punjab at least, produced without artifice or skill, there is but little to be said as to the origin and progress of its cultivation. The different kinds of wool are, and have been, localized for ages; the attempts to improve and cross different breeds, have been few and insignificant; and there seems hitherto to have been no desire among the natives, who rest abundantly satisfied with the breeds that exist, and neither know nor appreciate the benefits of improvement.

Whatever has been done, such as the attempted introduction of Merino wool into Hazara,* or the production of pashm in Spiti, is due to European endeavours.

Much remains to be done in improving and extending the produce, and still more, in introducing good methods of cleaning, dressing and working up the wool. On this subject in 1863, MR. MACLEOD wrote as follows:†—

"On the plains of the Punjab, I believe that there is a fine field for the application of European capital and skill to the production of superior varieties of wool. And I think it highly probable, that the merino sheep, or at all events half breeds, would thrive well if properly cared for. Large extents of grazing lands can be secured in many parts,—the climate, though hot and trying to the European constitution, is dry and not unhealthy,—and I believe that there are gentlemen in the Punjab, well suited for the charge of an experimental sheep farm, if Government should think it

worth while to establish one; as I have remarked on a former occasion, I believe the climate of the Salt range, where the Dumba or fat-tailed sheep, is apparently indigenous, to be the best suited of all for the purpose, but the extent of grazing land there is limited."

It is almost impossible to estimate the external trade of the Punjab in wool, nor are there any statistics from which the quantity supplied to foreign countries can easily be ascertained. The trade in wool to Great Britain has wonderfully increased: it originated no further back than 1833, with the insignificant quantity of 3,721 lbs (all India), in 1858 the quantity had risen to 17,383,507 lbs! and this is probably very much under the present rate of exports.*

Under the microscope wool exhibits a structure consisting of a series of serrated rings, imbricated one into another, like the joints of an *Equisetum*. The filaments of the fine qualities, writes PROFESSOR BRANDE, are varied in thickness from $\frac{1}{1100}$ to $\frac{1}{1000}$ of an inch. Wool possesses, unlike silk and cotton, the remarkable property of *felting*, i. e., its fibres adhere together forming a compact mass. Felt hats are manufactured by simply taking advantage of this *felting* property, the fibres being pressed together; this property is known to natives, who manufacture extensively a "namda," or thick felt. This felting property exists in greater extent in most of the hard coarse wools. If requisite the property can be destroyed by passing the fibre over heated metal combs, which process destroys the laminae of the fibres.†

Wool naturally contains in its pores a sort of potash soap, called yolk, secreted by the animal: to this is owing the lather that wool gives when rubbed up in warm water, the

* The Hazara experiment, must I fear be pronounced a failure, it has gone on for some time past always dying a slow death, although not yet extinct. The people it is said do not want and could not use the fine merino wool.—B. P.

† (Revenue Report, 1862-63, p. 99).

* In DR. FORBES' Catalogue, the following figures appear as the total exports, from India to all parts of the world. The United Kingdom receives by far the largest share.

1858-59	the exports were	15,638,196 lbs.
1859-60	"	19,562,897 "
1860-61	"	21,382,405 "

† See "Philosophy of Manufactures, p. 91. 2nd Ed.

"yolk" is especially abundant in the wool of the merino sheep.

It has been observed that the nature of the soil on which the sheep and goats are fed has most influence on the texture and quality of their wool.

Sheep whose pasture grows on calcareous poor soil have short harsh wool, while those on rich loamy argillaceous soils, have longer and softer hair. The influence of the temperature and the atmosphere is also no doubt considerable.

The same animal produces different kinds of wool. On a sheep the finest wool is on the spine from the neck to near the tail, including one third of the breadth of the back. The second kind of wool covers the thighs and shoulders, the third clothes the neck and rump, and the fourth on the lower part of the neck and breast down to the feet; and also upon a part of the shoulders, head, and thighs, to the bottom of the hind quarter.

There is also a very marked difference in the kind of wool yielded by the pashm goat.

Camel's hair is of two qualities; the under or soft wool is that which is in use for manufacturing chogas.

HILL WOOLS AND PASHM.

Pashm is a downy substance growing next the skin and under the thick hair of the Thibetan goat: it is of three colors, white, drab and dark gray, or "túsha." The best kind is monopolized by Kashmír, and is the product of Turfán and the provinces of Chinese Tartary. The Punjab is supplied from Changthán, whence the wool is exported by Leh to Amritsar, and the other shawl weaving cities of the Punjab. Rámpúr, is a great mart for the reception and forwarding of wool. The prices usually are Rs. 3 or 4 a seer of uncleaned, and Rs. 6 to 7 a seer of cleaned pashm:—"túsha" wool sells at Rs. 2 to 3 a seer, and if cleaned Rs. 5 to 7 per seer.

Pashm is the chief article of trade in Khutan and Ladákh. It is cut once a year; the

wool picked out is sent to Kashmír, but the hair is made into ropes, coarse sacks and blankets. After the hair of the goat has been cut short with a knife in the direction of its growth, or from the head towards the tail, a sort of comb is passed in the reverse direction and brings away the finer wool almost unmixed with the coarse hair. If not shorn as the summer commences, the animals themselves rub off the wool.

Moorcroft (Vol. II., p. 347) mentions that, "by ancient custom and engagements, the export of the wool is exclusively confined to Kashmír, and all attempts to convey it to other countries are punished by confiscation. In like manner it is considered illegal in Rodokh and Changthán to allow a trade in shawl wool except through Ladákh; and in the latter country considerable impediments are opposed to the traffic in wool from Yarkand, although it is of superior quality and cheapness;" but in these days a good deal of shawl wool is brought by different paths on sheep to Rámpúr, and sent from thence to the Kashmír colonies in the Punjab.

The goats are found domesticated all over the mountainous country of western Thibet, particularly in the provinces of Ladákh, Rodokh and Garo. Changthán is the name given to the elevated plateaux, where innumerable flocks are pastured.

704.—[5536]. Pashm wool from Bashahr. RAJA OF BASHAHR.
Simla.

705.—[5537]. Goats' hair. Bashahr. Rampúr, of Bashahr, besides being productive of sheep and other wool in itself, is the great market for the Changthán wool. Its trade and exports are noticed further on.

706.—[5560-64]. Series of shaw wools; Spiti. cleaned and uncleaned.
They are of a whitish gray color. The wool has

* Extract from MR. DAVIES' Report on the trade and resources of the countries of the N. W. Boundary of British India.

been twisted into a loose kind of rope, and the rope again made up into a long thick roll or coil, in this state it is usually sold or bartered to the traders.

The district of Spiti, geographically part of Ladakh, was purposely annexed to the British territory in 1846-47, in order to prevent the interposition of a foreign state between Rampur and the shawl-wool districts of Changthan.

The shawl goat thrives in Spiti, though the wool is not reckoned equal to that of Changthan. The Maharaja was in 1847 excused from rendering shawl-goats under the stipulation of the treaty, in consequence of the animals dying at Dharmasala, where they were kept. It is apprehended that sufficient pasturage for any large number could not be found in Spiti.

707.—[]. Series of pashm. From Lahore. LAHORE MUSEUM.

White pashm, uncleaned, from Kashmir.

White pashm, cleaned: value Rs. 8 a seer.

White thread spun at Lahore: value Rs. 16 a seer.

Another thread: value Rs. 12-10 a seer.

708.—[]. *a.* Brown pashm, "pashm khud rang." GHULAM NABI. From the Moti bazar, Lahore.

b. White pashm, ditto.

c. 2nd quality pashm, ditto.

d. 3rd coarse quality pashm, ditto.

e. Thread of coarser pashm: value Rs. 8 a seer.

f. Thread of Tusha pashm: value Rs. 4 a seer.

The pashm that comes to the Punjab comes from Changthan; there are two qualities, one "khalchak" (superior) and "ralchak" (inferior). The export from Changthan is about 700 maunds, which sells at Lé for from Rs. 60,000 to 70,000.

The MAHARAJAH OF KASHMIR keeps a monopoly of this wool as he does of Turfani wool,—at least of the quantity annually exported from Changthan to Lé. The whole of it is taken to Kashmir, Balti, Kashtwar Doda, and Bhadrawa, in the MAHARAJA'S territory. The inferior stuff only is taken to Balti; The Punjab shawl-weaving towns are supplied with Changthan shawl wool (the only wool they have as yet been able to secure for themselves) from Rampur. The merchants of this place bring down large quantities from Ghar-garo, or Gurdokh, in Changthan, where a large commercial fair is held

annually in August (Bhadon). The Lahaul traders bring Changthan wool through Ladakh.

The Kashmir collection (5609-5692)

Kashmir. (5700-5711) presented an extensive and interesting

series of the varieties of wool, and of the various places of production.

709.—[5683]. Shawl wool, from Káshghar.

White wool, from Changthan.

White wool, from Turfan.

Black wool, from do.

"Túshí" wool, from do.

"Kamál" wool, from Changthan-Kamal.

"Kalchak," wool, from Kalzak.

710.—[5770]. Kháshghár pashm (quality inferior to the first series).

Changthaní wool, with a sample of black wool.

Pashm, from Kamál, Ladakh, and China.

Coarse wools, from "Kashmir and Kalzak."

The following particulars regarding pashmina, are extracted from a paper in the Proceedings of the Agri-Horticultural Society of the Punjab, entitled, *A rough Sketch of the article called Pam or Pashm; the different varieties, places of production, and of the manufacture into Shawls, forwarded by F. H. COOPER, Esq., C.B.*

Wool of the first quality.—This is termed "shah-tash," and is produced in the Mongole and Khalkass ranges. It is the inner winter coat or fine downy wool of a small species of wild goat, there called "thosh;" and is valued highly in those regions, on account of its supposed limited production and high price, as well as its absorption and perhaps monopoly, not only by the native chiefs where produced, but by the magnates of Russian Siberia, who prize it highly for some medicinal properties, which it is supposed to possess. It is very scarce, and only brought down to Kashmir occasionally, and in very limited quantities, mostly in small round balls of fine spun thread, and very rarely as raw wool. Consequently, at Kashmir, it is not a marketable article, and not found in commerce. But people of wealth in Kashmir, at whose request it is thus occasionally brought down by the

Argouns, have it usually made for private use into plain shawls without any work, called *sādhā chādhur*, from 4 to 6 yards in length, and 1 to 1½ in breadth, or into stockings, gloves, caps, and undervests, &c. It is of a fine soft white color, but its price altogether depends upon fancy. Plain shawls, or *sadhā safed chādurs* of shah tūsh, are known to have been purchased at Kashmir, at from 80 to 180 to 200 rupees.

2nd.—This material is the same as the first in every respect, with the exception that its natural color is gray, it is called *khudráng tush*, or “tush of its own color,” to distinguish it from the above or white variety, called shah tūsh; and although preference is usually given on account of the white color to No. 1, still the difference in the estimation or value of either, is considered but a mere matter of fancy.

3rd.—This is the much famed *Túrfáni pashm* of Kashmir commerce, and shawl manufacture. It is the production of the *Túrfán Aksu*, Kamal, and other hill districts, ranges east and north-east of Yarkand; it forms the inner wintry coat of the domesticated goat. It is brought down by the *Argouns* to Kashmir *viā* Yarkand, in the form of coarse or uncleaned pam or pashm, mixed with the outer hair of the goat in various proportions, but separated at Yarkand or Ladakh from the *Túrfáni Khudráng pam*, or colored variety. This white but coarse *Túrfáni pam* is sold in the Kashmir market, according to the quantity of hair or impurities it may contain, at from 8 to 12 and 14 rupees weight for the Chilkee rupee of ten annas; but when cleaned and spun, it produces from 4 to 5 rupees weight of thread, or *tár-i-pam*, which sells according to the fineness of the thread, at from half a rupee weight to 2½ rupees weight for one rupee Chilkee—while the value of the shawls, according to the manufacture, may vary from 70 to 5,000 rupees. This pam contains no scurf, dander, or scales from the skin of the animal, which allows of its being easily cleansed.

4th.—This is the *Changtháni wool* and most common in the market; it is the produce of the domesticated goat of the *Changthán* province, and may be said to be produced along the northern base of the ranges, from about Rodokh in the west, or even from the banks of the Shegak, eastward to the *Kailás* ranges, north of *Mán-Thaloi*, or Mansarowar lakes; and even it is said as far as *Lhass-Laass* (Anglicé Lhassa). This wool is brought to Kashmir *viā* Leh or Ladakh, not only by the *Argouns* but also by numerous other traders; on account of the quantity of hair mixed with it, as well as the scurf or dander which it invariably contains, it sells at from 10 to 16 rupees weight for one rupee Chilkee. It produces also from 4 to 5 rupees weight of *tár* or thread, which sells at the same rate as that of the former, or No. 3 quality.

A rupee's value of either pam in the coarse state, produces the same quantity of *tár* or thread. The “*tár-farosh*,” or thread-dealer, after he has made his purchases, then separates the *Túrfáni* from the *Changtháni* thread: this he easily discriminates by the practised touch of his hand, which enables him afterwards to sell either, or both, to the shawl weavers to advantage, according to the market rate. The shawls made entirely of this pam, are not usually manufactured into such costly articles as those of the *Túrfáni* wool, but it is the usual practice to make use of both in the manufacture of all shawls, at present, so that their price or value becomes thus equalized.

5th.—This is the article, called *Túrfáni tús*, as also *khudráng pam*, or naturally colored wool. The *Túrfáni* and *Changtháni* coarse *khudráng* wools are usually mixed and sold together, at from 12 to 18 rupees weight for one rupee Chilkee, which produces from 5 to 6½ rupees weight of thread which sells according also to the fineness, at from three-quarters of the rupee weight to 3½ ditto for one rupee Chilkee. This is usually made into plain shawls, or *sadhā chādhur*, the usual price of which range from 35 and 40 to 80 rupees.

6th.—This is quite a different article from any of the foregoing, its only title to be classed here is its carrying the name of pam with it. It is derived from the water-fowl, as under the name of *brej* or *brege pam*, an article which occasionally comes down from *Siberia* (Seebere, Seetha, or Seeth, by the natives) (*Seythia*?), usually as a lining to *postins*, caps, stockings, gloves, neckties, &c., from its nature it cannot be spun into thread; it is of a white color, with a certain gloss, and supposed to be a species of eider down—it is fancy priced.

Miscellaneous Remarks—All, or most of the mammalia of the above named countries, and other similarly situated localities at an elevation of 11 to 13 and 14,000 feet, which are consequently subject to severe winters, and a high rarity of atmosphere, whether domesticated or wild, such as the dog, yák, or kárhgan, &c., &c., possess a wintry inner coat of pam, of different degrees of fineness. The pashm of the goat is alone the marketable commodity; besides this the hair of the yák and Kirghiz camel is in parts cropped: and both in a cleaned and coarse state are made into cloth of different degrees of fineness for Kirghiz (nomadic) tents, clothing, bedding, saddle bags, ropes, &c., &c. The hair picked from the marketable pam at Kashmir, constitutes a different branch of manufacture of ropes, saddle bags, and hair cloth of different kinds, qualities, and uses. The *Argouns* are Mahomedan Kashmir emigrants, or the descendants of such who have settled in Ladakh, Yarkand, Changthán, or in any part of Chinese Tar-

tary, for policy and security : they usually have establishments with agencies at the principal towns and cities they frequent and trade with. Thus, the Argoun of Ladákh, besides his original or primary establishment at Ladákh, has another at Yarkand, and also perhaps according to his means or extent of trade, at Aksu, Ilchi, Túrání, &c. ; while the *Argouns* of Yarkand, as also the Khojas of Andejan, are known to have establishments in many towns and cities of Russian Siberia. In Chángthan, at the Arghils cattle sheds, and Yaitaaks pasture grounds, the usual price of the raw article or coarse pam is about 2 vuttees (4 seers pukka, or 8 lbs. English) for Rs. 3, or about 6 annas the lb. weight, and tobacco is bartered for about double its weight of coarse Changthan pam. So also green and red dyed goat skins of Punjab manufacture, with shoes, and boots of the same article (the latter made in Turki fashion) are bartered at Yarkand, Aksu, Ilchi, Túrání, &c., for treble and quadruple their weight of raw pam. In the same manner not many years since, the glass beads and buttons of Birmingham were wont to be bartered for an equal weight of gold dust, or regh-i-zar throughout the entire country of Ghilghit, Yarkand, Mazhhuji, Chitral, and along the south base of the Múz Thangh, and Khara Kháram.

Even now Russian iron-ware, pots, pans, brass buttons, trinkets, gaudy colored silk handkerchiefs, &c., find a free barter traffic north of the Khara Kháram, among the Pamir Khirghiz, and round the different sources of the Amúr or Oxus. The raw or coarse pam is cleaned or prepared for spinning by women, girls, and boys. The plucking and separating the hair from the pam is the first process, after which it undergoes a regular series of manipulations, with fine damp rice flour made by steeping the rice two or three days, and afterwards pounding or grinding it in a moist state on a stone slab, or in a shallow wooden vessel, called *praathera*, with a stone pestle. When thus properly cleaned, the pam is put into a clean earthen vessel and thence taken in small quantities of a few grains weight at a time for the purpose of undergoing a process called *támba*. The operation called *támba* consists in opening out and separating the fibres, removing knots, clots, impurities, &c., with the fingers and thumb of both hands, during which process, the pam dries and lets fall all the rice flour : when this process has been repeated several times the pam becomes ready for spinning by females, young and old. They again sell the thread to the *tár-farosh*, or thread dealer, who, as I have mentioned, separates the Thúrání from the Chángthan thread, and sells it as required to the shawl báfs or shawl weavers.

The shawl báfs, according to their means, keep

up an establishment of from three to four hundred *shagirds*, or apprentices, of children from five years of age, to old men and women of eighty. The shawl báf pays to Government a capitation tax of from 16 and 18 to 50 rupees per annum, for each shagird that he employs.

When the shawls are made, they are brought to the Government Superintendent of the shawl manufactory, or Head Contractor of such, and by his orders the shawl undergoes a certain examination and form of valuation, the result being that the shawl is stamped (shawl-dágh) according to its real or supposed full value, and a stamp duty is there and then levied upon the shawl, of from 50 to 60 per cent. of the full valuation. Besides this, *presents* have to be given, and are expected on all these and other occasions—such as, births, marriages, &c., by not only the Head Superintendent or Shawl Dágh Contractor, but by all his minions from the highest to the lowest. The climax to such matters does not arrive, until the Head Superintendent, for some cause or other, is pleased to feel disapprobation with the shawl báf, when most, perhaps all, of his apt and able work-establishment or shagirds are abruptly removed and placed under the charge and care of a more lucky master weaver ; and in lieu of them the unfortunate shawl báf gets a number of incompetent shagirds who are almost useless.

The Argoun merchants and traders of Ladákh and Changthan have made it a point, from time immemorial, to advance large sums of money for the purchase of pam throughout the different districts of the pam producing provinces. But they wisely place their money in the hands of the authorities and chiefs, both secular and religious, of those provinces, and propitiate with yearly presents not only these provincial *Lhamas*, and other dignitaries, but also the great *Lhamah* of Lhass himself. They thus obtain not only full security for their money, but also secure a permanent yearly supply of the shawl wool, and thus, in turn all or most of those Argouns, have been cleverly induced for many years past, to trade solely with Kashmír, *viâ* Ladákh, in preference to other marts.

It is only for the last 20 years that the Túrání and Kuchari shawl wool has been exported into Kashmír from Yarkand. Before that period, the Changthan wool alone was used in Kashmír. The Ladákhs would never clean the wool from the pieces of skin and coarse hair found in it in its raw state. The Kashmíris, after the conquest of Ladákh by the Dogras, succeeded in cleaning it by first steeping it in lime water. The process now performed by the Túránís and others who are thus able to export good stuff free from dirt, coarse hair, &c.

711.—[5562] Bukhára Pashm. LOCAL COMMITTEE, PESHAWUR.

This is produced at from Rs. 1-8 to 4 a seer ; it is imported into Peshawur to the value of Rs. 40,000 yearly : it is a superior wool, though inferior to that of Thibet.

712.—[5559], Antelope wool. Lahaul. TARA CHAND.

Called "tsodkyi-lena," (or properly hRtsodkyi-lena. Thibetan,) and is very precious.

713.—[]. Ibex hair, being the wool of the teringole, or ibex. P. EGERTON, Esq.

This is the wool that makes the famous and rare ibex shawls ; the animal is also called "kin."

HILL WOOLS OTHER THAN SHAWL WOOL.

714.—[5532-33]. Wool from Bhaji Simla. and Bhagal, by the RANAS.

715.—[5534]. Black wool. Balsan. RANA OF BALSAN.

716.—[5541]. Wool, from Chumúrti. MR. G. JEPHSON.

Mr. Jephson also exhibited a sample of ordinary Simla hill wool (5542).

717.—[5545-46]. Sheep Kangra. wool, second quality.

718.—[5447]. Species of Kúlú sheep wool, from Kothi mûlí. LOCAL EXHIBITION COMMITTEE.

719.—[5448]. Goats' hair. Kangra district.

720.—[5555]. Sheeps' wool, black Lahaul. and white. Lahaul. TARA CHAND.

Called "luggi-bal," it sells at present for 6 kutchas seers per rupee, but a few years ago it was 7 ; the demand has much increased : it is exported to Kúlú and Kanáwar.

721.—[3536]. Yaks' wool. Rupshu and Zangskar. TARA CHAND.

Called "Kúlú" : the soft under hair of the yák, used to make bags for sheep loads, and the felt soles of shoes.

722.—[5557]. Sheeps' wool. Chang-thán. TARA CHAND.

Value 3 seers per 1 rupee.

723.—[5550]. Goats' wool. Chang-thán. TARA CHAND.

Called "ramai lena." Value 2 pakka seers for Rs. 4, 5, and 7, according to circumstances.

724.—[3565]. Wild sheeps' wool. Spiti. P. EGERTON, Esq.

The wool of a wild sheep killed at Spiti by MR. EGERTON.

725.—[5566-7-8]. Sheeps' wool, of three qualities, TEHSILDAR OF SPITI.

The following passage descriptive of sheep in Spiti, is taken from MR. DAVIES' report.

"The mountain paths between Rampúr and Spiti are so precipitous that sheep, more sure-footed than larger beasts, are commonly used to carry burthens of from 16 to 20 lbs. The sheep are driven from village to village with the wool on, and as the required quantity is cut from their backs, they are laden with the grain which is received in exchange, and which when the fleece is all disposed of, is carried into Chinese Tartary, and sold at a profitable rate. It is the custom for the shepherds of Chumurti to give an order while the crops are yet green and on the ground, for any amount of grain they may require, which, when the crop is ripe is stored up by the cultivator until the summer of the ensuing year : when the shepherd arrives with his flock, he gives the wool in exchange and receives his grain, which he puts into small bags, and drives back his flock thus laden."

726.—[5570-71]. Sheeps' wool, cleaned and uncleaned. NONO OF KULJANG, SPITI.

This wool was sent to compete for the prize for the best wool in the Punjab. The sheep are shorn only once a year.

The sheep appear to be of two distinct breeds. The common one produce the fine Bhíoaighi wool, and the other is a very large species, which is brought from Chumúrti with very long wool, but not so fine as the other.

The goat is the description which produces the shawl wool or pashms.

The total number of sheep and goats in this place is 1095.

727.—[]. Sheeps' wool, from Rampúr Bashahr. MR. STEPHEN BERKELEY.

About 2000 maunds of wool are annually brought to Rámpúr, and about half that quantity of pashm. The price of the wool averages about 4 lbs. for the rupee, and pashm Rs. 2-4 for 2 lbs.

Washing the wool is a very tedious process. It is spread on to a plank which is slightly sloped, hot water is then poured on the wool, which is at the same time beaten with a flat stick. Care is taken not to entangle the fibres of the wool; which, when clean, is spread out to dry. It is absolutely necessary to wash wool on a sunny day, or it is likely to get entangled if left wet for a long time.

728.—[5573]. A series of yaks' tails, used for chauries. Spiti. LOCAL COMMITTEE, KANGRA.

The following is CAPT. HAY'S account of the yaks at Spiti. I give the passage entire, as it contains a notice of the other domestic animals of that remote region.

"These animals consist of yaks, jubbos or half yaks, cows, "ghoonts," asses, sheep, goats, dogs, and cats.

"The yak is a highly useful animal—with it the people plough, and carry loads, it furnishes also milk, and hair to make ropes.

"In the severest weather this animal appears to enjoy itself in the snow, and is often to be seen with icicles of several inches in length hanging to its nose, and a foot or more of ice hanging to the hair which falls from its neck and shoulders. Long hairs hang over the eyes and prevent their freezing. The total number of yaks in Spiti is 439, and of jubbos and cows, 412.

"The numbers of asses 79. They are strong, but of a small breed, they principally carry fire-wood, and their milk is drunk.

"Each village has its 3 or 4 dogs, and a very fine species of black cat.

"The ghoont, though a useful animal, seldom carries any burden but a man: the total number in Spiti is 265; they are bred chiefly for sale. They have two breeds—one a small ghoont, never above 12 hands high, peculiar to the country; and the other a large breed, from 13 to 13½ hands high, is bought from the Chinese, and usually comes from Choomoortee. For a Chinese ghoont two years old, they give a Spiti ghoont four years old. All are equally hardy and are kept out the whole winter, except the yearlings, which are housed. During winter the ghoonts live on the roots of the stunted bushes, and are very expert at scraping the snow from off them with their forefeet. The breed of ghoonts might be improved with a little care. Many are killed during winter by wolves and leopards.

729.—[5682]. Wool. Srinagar. H. Kashmir. H. THE MAHARAJA.

730.—[5683]. Wool, from Ladakh. H. H. THE MAHARAJA.

Besides itself producing wool, there are large imports to Ladakh of wool from Rudokli, &c. From the latter place, Rs. 20,000 worth reaches Ladakh, and Rs. 30,000 worth goes to Rampur.

WOOLS OF THE N. W. FRONTIER.

II. We now come to the second class of wools, produced at or about Peshawur, Kábul, Kandahar, and Persia or Kirmán.

The most interesting varieties of wool are, —1st, that of the *Dumbah*, a large tailed sheep, at Peshawur and Kábul; from the latter place it obtains the name of "kábli pashm;" it is used in the manufacture of "chogas" (cloaks with sleeves) as worn by the Afghans.

2nd. Is "pat," the hair of a goat common in and about Kábul; fabrics called "pattu" are made from this.

3rd. Is Kirmáni wool, a beautiful white, very soft wool, produced at Kirmán it is called "wahab sháhi."

4th. There is Kandahári and Bukhára wool, among which we may include the Karakuli lamb skins* of Bukhára.

This class is represented in the Exhibition by the following:—

731.—[5595]. Wool of Dumba Sheep Peshawur valley. LAHORE MUSEUM.

732.—[5566]. Wool from Peshawur. Peshawur. LOCAL EXHIBITION COMMITTEE.

Wool obtained from the fat-tailed variety of sheep is used in the manufacture of clothes and carpets, and also exported to India. It is of wide distribution; the sheep abound at Peshawur, Kábul, Kandahar, Herat, and other places: Kelat and the surrounding country produces sheep's wool in great abundance. This sheep is apparently indigenous also to the Salt range.

* The lamb skin (with the fleece on) of Karakul (a district about 20 cos distant to the south of Bukhára, is famous. About ten lacs of rupees worth of these skins, the produce of Karakul and other districts of Bukhára, (all being called "Karakuli," is annually exported from Bukhára to Persia, Turkistán, Russia, Kábul and India. The greatest quantity goes to Persia, where the people make caps of "Karakul," called "pupakh." A piece of the best description of "Karakuli" sells from Rs. 25 to 16 in Persia.



CSL



THE YAK

The following account of the trade in these wools from Kandahár, is extracted from COL. LUMSDEN'S Report on Kandahár.

At Birgand, Hazara, Herát and Kandahár, when advances are made to the nomads on the future crop, the price on the spot is about 12 company's annas per Kandahári maund of 4 company's seers; but if purchased at the time of shearing it cost Rs. 1-4 for the same weight; and if taken on credit Rs. 1-8. A load of 48 maunds Kandahári or 192 company's seers is carried to Kandahár from any of the districts above-mentioned for company's Rs. 12-8, and from this point to Kuráchi for the same sum. The reduced rate for the latter distance is accounted for by the road being better, and below Dadar, perfectly safe. The gomashita, or agent, proceeding with the investment, receives two-thirds of the profits, taking an equivalent share of risk; but if the arrangement with him is made on the Mahomedan principle (known as Mozaribat), when the agent runs no risk, one-fifth of the profit is absorbed in his pay.

The agent in Kandahar says that, the tariff of boat-hire from Karáchi to Bombay varies so much, that it is impossible to give even a fair approximation to the expenses of transit: the price in Bombay may

be put down as Rs. 192 per kándi of sixty Kandahári maunds. Pure white wool is the most marketable; but brown and white are frequently mixed. The wool of Birgand and Herát is generally shorn twice a year; and if not exported, is manufactured into carpets, "balázins," Masnadi namads, and common felts. The fine wool known as Kurak, is procured from goats in the Herát, Gazak, and Hazara districts.

733.—[]. Kirmani wool. Several samples were exhibited, which were not included in the Catalogue, and some of these were of great beauty.

Kirmán is a tract of country close by the Persian Gulf, to the south of Persia.

The wool finds its way into the Punjab in considerable quantities. It is a soft delicate wool, but its principal use at present unfortunately appears to be the adulteration of genuine pashm. A Table is annexed showing the imports of real pashm and Kirmáni wool into Amritsar, side by side: the increase of the latter is marked: the subject of the adulteration will be resumed when we come to speak of manufactured shawls.

Statement of Kirmáni wool and real pashm imports in the city of Amritsar from 1850-51 to 1861-62.

REAL PASHM.				KIRMANI WOOL.				Remarks.
Year in which imported.	Quantity imported.			Year in which imported.	Quantity imported.			
	MDS.	S.	CH.		MDS.	S.	CH.	
1850-51	1,300	...	...	1850-51	40	...	...	There is no scarcity of pashm, but the agents from Amritsar no longer go up to Bishahr for it, owing to increased import of Kirmāni wool. This inferior wool has put the real pashm out of the market.
1851-52	1,250	...	...	1851-52	100	...	...	
1852-53	900	...	...	1852-53	250	...	...	
1853-54	950	...	...	1853-54	300	...	...	
1854-55	850	...	...	1854-55	400	...	...	
1855-56	700	...	...	1855-56	400	...	...	
1856-57	600	...	...	1856-57	500	...	...	
1857-58	600	...	...	1857-58	700	...	...	
1858-59	500	...	...	1858-59	700	...	...	
1859-60	400	...	...	1859-60	800	...	...	
1860-61	400	...	...	1860-61	1,000	...	...	
1861-62	500	...	...	1861-62	1,000	...	...	
Total, ...	8,950	...	...	Total, ...	6,190	...	...	

MR. DAVIES writes thus :* "it is evident that the quantity of shawl-goat's wool imported into Amritsar has, for several years past, decreased. In its stead, sheep's wool from Kimán in Persia, has been largely introduced into the manufacture of shawls. This wool is fine of its kind, and long in the staple. It is much more easily and quickly worked than the more delicate goat wool. It is largely used in Persia in the fabrication of "jámewars," which have superseded the use of Kashmir shawls in that country."

WOOLS OF THE PLAINS.

III. We come to the last class, representing the wool of the plains.

Among these I have included the wools of Hazara, because they could not very well be included in any other. It is here that the first attempt at improving the breed was made, by the introduction of the merino sheep; but there does not seem any great prospect of success. Merino wool that was sent home in 1860, fetched 1s. 6d. a pound. At present, merino wool in Europe is chiefly produced—the best in Spain, the next best in Saxony. However unsuccessful the experiment may be, there are many other ways in which the breed of sheep might be improved, and the wool trade stimulated: of pasturing grounds there is no lack.

"There can be no doubt," wrote the Financial Commissioner in 1861, "that the valleys of the Sutlej, Rávi, Chenab, Nainsukh and other tributaries of the Indus supply grazing grounds, not to be surpassed in any part of the world. The population inhabiting these are chiefly pastoral, but owing to sloth and ignorance, the wool they produce is small in quantity, full of dirt, and ill cared for in every way."

The kinds produced are—

1. Black and white sheeps' wool, for blankets, &c.
2. Goats' hair, for grain bags, rope, &c., &c.
3. Camels' hair: the inner wool is used for chogahs of a common kind, and is very

soft. This wool is produced in the "bar" and "thal" tracts of Shahpúr, Rohtak, Jhang, and Gugaira, which are camel feeding districts.

The collection is thus represented:—

SHEEPS' WOOL.

734.—[5521-22]. Black and white
Delhi. wool. MUNICIPAL COM-
MITTEE.

735.—[5644]. Wool of the flat tail-
Shahpur. ed sheep. Salt range. DE-
PUTY COMMISSIONER.

736.—[5648]. Common wool, from the
"bár" tracts. DEPUTY COMMISSIONER.

737.—[5527]. Sheeps' wool. LIEUT.-
COL. VOYLE.

Wool was also exhibited from—

Ambálah (5530 and 31).

Jalandhar (5543).

Lahore (by BADRINATH DALAL).

Gujranwalla (5632).

Gujrát (5638): value, 3 seers per rupee.

Rohtak (5527).

Gugaira (5648).

Jhang (5651).

Muzaffargarh (northern portion) (5653).

Dera Ismaíl Khán (5656).

Dera Ghází Khán, two samples (5658-59).

Bunnoo (5661).

In which district it is stated to be produced in large quantities, and exported to Sakkar; its value being Rs. 16 a maund.

Jhilam (5462).

Maler Kotla also exhibits black and white wool of superior quality (5518-19).

738.—[5694]. Black wool, from Ká-
Hazara. ghán. LOCAL EXHIBITION
COMMITTEE.

739.—[5675]. White wool. LOCAL
EXHIBITION COMMITTEE.

740.—[5676]. Half bred merino wool.
Kághán.

741.—[5677]. Introduced merino
wool. Abbotabad.

* Report on Trade Resources of N. W. Frontier Provinces, &c.



"In regard to wool, there is nothing new to communicate of an encouraging nature. When passing through Hazara in April, I saw the merino flock; and was greatly disappointed in it. It is under the care of a shepherd from Hindostan, who appears not at all to like the cold of the hills; and will not willingly venture into the localities best suited to the sheep. The latter appeared to me to be in a most wretched condition, offering a great contrast to the half breeds reared by the Sayads of Kaghan, who confess the wool obtained from these to be much softer and finer than that of their own sheep; though they do not appear greatly to appreciate these qualities. I consider, as I have heretofore stated, that there is no prospect whatever of merino wool being produced to any extent in our hills; or of any wool, least of all the finer kinds, being allowed to grow of sufficient length to be prized in the Europe markets; as the tangled and thorny woods and forests through which the sheep must pass, oblige the shepherds to shear them at least twice, and usually three times in the year. In the comparatively woodless tracts of Trans-Himalayan regions, wool of the finest kinds, and I believe of considerable length, is produced almost everywhere, apart from the inner coat or pashm; and enquiries are being made in Spiti, with a view to ascertain how improvements may be effected; and a superior as well as a more abundant article obtained. It seems to me, however, to be doubtful whether any considerable increase of produce could be obtained from these regions, by any available means, at all events, not under existing circumstances."

742.—[], Sheeps' wool, from Leia.

In this pergunah sheep are shorn twice a year, once in Bysakh and again at the end of Katak, or beginning of Maghar; from the wool blankets are made, also a few kinds of cloth for putting under saddles,

called "sankar;" goats are sheared in Bysakh, as are also camels.

GOATS' HAIR.

This is very commonly produced in almost every district, and called "jat." It is used for making ropes, also for matting, and for the strong bags wherein grain, &c., is carried on the back of oxen. Grain dealers use rugs made of it in the shops in which the grain is poured out when being winnowed, or weighed out.

Goats' hair is exhibited from Rohtak (5528).

Jalandhar (5544).

Gujrat (5639).

Shahpur (5645), where it is produced in the "bar" tract.

Gugaira (5649).

Jhung (5652).

Maler Kotla (5520), in the form of hair rope.

CAMELS' HAIR.

The soft under wool is of a light-brown color: it is made into chogas of a cheap kind, but they are soft, warm, and useful.

The long hair is not made use of; nor is there any sample exhibited. It is employed in Europe for making paint-brushes.

Camels' hair is exhibited from—

Rohtak (5529).

Shahpur from the "thal" tract (5647).

Gugaira (which is a great camel bearing district) (5650).

* Extract from Revenue Report of Hazara, 1862-63.

It is a matter of great regret that a Report on the Wools and Silks of the Punjab Exhibition of 1864, which should have accompanied these pages, has never been completed, owing to the absence of the Reporter, PUNDIT MUNPHOOL on special employment beyond the frontier. The list of awards made by the Jury is however, given, as it will serve to show who were the successful rearers of silk and wool in 1864, and what districts carried of the palm.

I. WOOLS.

District or Locality.	Prize taken.	Description of Article.	Share.	Medal.	Certificate.	Special Prize.	Remarks.
1. WOOL FROM THE HILLS.							
Spiti,	Tehsildar,	{ Sheep's wool, } No. 5560	..	1	1	..	Mr. Macleod's Special Prize.
Bashahr,	Raja Bishahr,	" 5536	..	..	1	1	
Hazara (Kaghán),	Loc. Ex. Committee,	" 5675	16	..	1	..	
Hazara (Abbottabad),	"	" 5677	15	..	1	..	
Ladakh,	Maharaja Kashmir, ?	Sheep's wool,	13	..	1	..	
Kulú (Siraj),	"	"	..	..	1	..	
2. WOOLS FROM THE PLAINS.							
Shahpúr,	Dy. Commissioner,	Sheep's wool,	..	1	1	..	Mr. Macleod's Special Prize.
Do. (Bhaira),	"	No. 5645	..	..	1	..	
Jhilm,	Loc. Ex. Committee,	No. 5642	..	..	1	1	
Múltán,	" "	" ?	9	..	1	..	
Sirsa,	" "	" 6272	8	..	1	..	
Muzaffargarh, (Kotadú),	" "	" 5653	6	..	1	..	
Gujrát,	" "	" 6742	..	..	1	..	
Jhang,	" "	" 5651	..	..	1	..	
Gugaira,	" "	" 5648	..	..	1	..	
			67	2	15	2	
II. SILKS.							
Gurdaspúr, ..	Jáfir,	No. 5620	..	1	1	..	Mr. Cope's Prize of Rs. 50.
Lahore,	{ Nazir Khairullah } Khan,		..	1	1	..	
Gujrát,	Loc. Ex. Committee,	No. 5640	..	..	1	1	
Peshawur, ..	Mr. Huddleston, ..	..	8	..	1	..	
"	Subhán Mulick of Gurdaspúr,	..	8	..	1	..	
Kangra,	Tilok Nath,	..	7	..	1	..	
Kashmír,	H. H. The Maharaja,	..	7	..	1	..	
			30	2	7	1	



SUB-CLASS (E). ANIMAL SUBSTANCES USED FOR MISCELLANEOUS MANUFACTURES, PERFUMERY, DYING, &c., &c.

PERFUMES.

743.—[2500-2505] Series of musk Simla bags, “mushk náfa,” of *Moschus moschiferus*, from Sirmúr, Bishahr, Balsán, Kyúnthal, Kumharsen, and Kot Khái.

744.—[2502]. Thibet musk. RAJA OF BALSAN.

The Simla musk balls, which are presented as complimentary nazars by hill chiefs, are an inferior kind, and do not command anything like the price of the genuine Thibet balls. About 100 musk bags are imported from Changthán via Yarkand, of which about 40 go to Yarkand : the rest go to Kashmir and Jammú, and are taken by Yarkandi Pilgrims to Mecca for sale in India or other Asiatic countries : they are produced in the north-west of Rodokh and Nipal ; and value at Lé, 7 to 15 Rs. or at Yarkand from 21 to 26 Rs. In former times musk bags from the Dasht-i-Khuttan, or great Tartar desert, were in high repute, and fetched at the least 42 Rs. ; but all supply from that quarter has long ceased.*

The animal (the musk deer) is about the size of a young roebuck six months old. The color of the skin is blackish with a mixture of yellow and reddish-brown. It, however, varies considerably in the young animal, being then of a reddish-gray with patches of white arranged in lines, while in the old it is of a blackish-brown color. The most consistent character of the fur throughout the life of the animal is the presence of two white bands bordered with black, and enclosing between them a black band which extends along the under part of the neck from the throat to the chest. The tail has a heart-shaped space around it, naked in the male and always moistened with a strong smelling humour.

On the other hand the females, during the whole of life, and the males up to two years of age, have the tail covered with hair on its upper part, and with wool on its under part : the animal has no horns.

“The mouth opens as far back as the molar teeth ; and the male has two canines in the upper jaw developed into the form of tusks ; these teeth project externally on each side of the mouth, they pass downward curving backward, and have the posterior edge adapted for cutting. The eyes are proportionally of a large size, and have a long narrow pupil.

“The ears are moderately long, covered externally with reddish-black hair, and internally with long gray hairs. The hinder limbs are longer and stronger than the anterior. An important osteological character is the presence of a slender fibula extending from the head of the tibia to the extremity of the astragulus. The feet are small. The anterior have two spurs which touch the ground, the external being the largest ; the posterior have two unequal hoofs the internal being much longer than the external.

“The musk deer is a timid nocturnal mammal, very rapid in its course ; it has a leaping motion, something like that of the hare ; it leads a solitary life, except in autumn ; it feeds upon the leaves, bark, and roots of trees ; its flesh is good to eat.”*

Musk apparatus.—This consists of a sac, which is only present in the male ; it is placed on the median line of the abdomen, between the navel and the orifice of the prepuce and near the latter. The sac is of a rounded oval form, flat on its superior and adherent surface, but convex and covered with hair on its inferior or free surface.

In adults the sac is from two to three inches long, and 7 to 10 lines in depth. The envelope of the sac consists of three separate membranes. On the inner surface of the sac are strongly marked folds and excavations, each excavation contains two or more oval corpuscles, consisting of a very thin membrane, containing a brownish colored substance. These small bodies are glands for the secretion of the musk. Toward the middle of the external surface of the sac is a short canal, which passes obliquely, and has its internal opening marked by a number of converging hairs.

In the living animal, the musk has the consistence

* Memo. by PUNDIT MUNPHOOL on the trade of the Punjab and the countries within and beyond the Dominions of the MAHARAJA OF KASHMIR.

* Extracted from the Elements of Medical Zoology, by MOQUIN TANDON.

of honey, is of a brownish-red color, and has a strong odour.

When dry, the musk is almost solid, granular, and of a dark-brown color.

It feels unctuous and fatty, has a bitter aromatic taste and its smell is powerful. Each sac does not contain more than 370 grains in an adult, and 123 in an old animal.

Two kinds of musk are known in commerce, the *Tonguin*, or Chinese, which is the best; and the *Kabardur*, or Russian.

Musk contains ammonia and volatile oil, stearine, oleine, cholesterine, an oil united with ammonia, gelatine, albumen, fibrine, hydrochlorate of ammonia and several other salts.*

The musk that reaches England is imported from China in chests of from 60 to 100 ounces each. An inferior kind is imported from Bengal (Hill produce).† There is also a Siberian or Russian musk. The China musk bags are always observed to have been opened and sewn up again, and it is probable that adulteration is largely practised: the blood of the animal is often mixed with the musk.

The male animal produces the musk, and is a native of Eastern Asia, between the 30° and 60° north latitude. It is found in the Steppes of the Altai on the Irish river, extending eastward as far as the river Yenesei and lake Baikal.

In 1857, the import of musk into England was 10,728 ounces.‡

745.—[2530]. Musk. Kághán. DE-
Hazara. PUTY COMMISSIONER.

746.—[2513]. Musk bags. KAN-
Kangra. GRA HILLS.

These are an inferior kind, and value Rs. 3 to 5 each.

747.—[2531-2]. “Náfa-i-mushk-i-
Kashmir. Khatai.” Bags of fine
Thibet musk. H. H. THE
MAHARAJA.

748.—[4319]. ‘Atr-i-mushk or Kas-
Lahore. túri-attar, attar of musk.
RAM SING, Pansári.

749.—[4319]. ‘Atr-i-ambar, attar
of ambergris.

Ambergris, from which this attar is prepared, is found in pieces floating in the sea near the coasts of India, Africa and Brazil; it of an ash-gray color, spotted like marble with black spots; but it appears to vary considerably in color, some pieces being white, some black, and some gray with yellow spots. It is very light, and easily takes fire. It is most probably a concretion formed in the stomach or intestines of the *Spermaceti* whale, *Physeter Macrocephalus*.* Several specimens have been found full of the imbedded beaks of a species of *Sepia*, which is the food of the *Physeter*: it is supposed by some to be formed only during disease, as the specimens of the whale, in the stomach of which ambergris was found, were sickly.

LAC.

The lac insect is found more or less all over India; in the Punjab it is universal, and there is scarcely a district which does not exhibit a sample.

The lac exhibited is almost exclusively the produce of one or other of the three trees “pípal” (*Ficus religiosa*), “dhák” (*Butea frondosa*), or “bér” (*Zizyphus jujaba*). The dhák specimens have been sent from Kangra district, and also from Kapurthalla. The “bér” lac is the commonest; it is much produced in the Jhang and other districts, where tracts of waste land are covered with the wild “bér.” The other trees on which lac has been known to be produced—are *Annona squamosa*, *Vatica laccifera*, *Feronia elephantum*, *Schleichera trijuga*; two species of *Erythrina*, *Ficus indica*, *Inga dulcis*, *Mimosa cinerea*, and others, and species of *Aleurites*, *Croton*, *Carisa*, and *Urostigma* and *Celtis*. There are six Hindí names for lac, but the name lák or lákshá, is derived from the word, signifying “a hundred thousand,” from the great number of the insects which swarm over the tree. By the punctures they make on the tree, the “lac,” is produced.

The products of this insect are two—(1), the “gum lac,” which forms a concretion like bubbles over the twigs of the trees on which it is produced; (2), the red coloring matter,

* MOQUIN TANDON, Medical Zoology.

† MACCULLOCH’S Dictionary of Commerce.

‡ DR. UBE, Dictionary of Arts, &c.

• THOMPSON’S Chemistry.

to be noticed presently, which yields the highly prized and permanent lac dye.

It is the female insect of the *Coccus lacca* that produces the resin and the dye. This is a small round red colored flat insect, having 12 abdominal rings, and a bifurcated tail. The male is much larger than the female, and is furnished with wings; it is stated that no more than about one male to 5000 females is to be met with. The female insect is said to be destroyed in the process of producing her young ones, for the eggs become hatched beneath the mother insect within the concrete resin globule, and escape by boring through the mother's back. At first the young brood having made its escape clusters on the twigs of the trees, and very shortly afterwards the incrustation of lac begins to be formed over and round them, covering the twigs. The bubble like exudations are all close together, and hollow and cellular inside. About the end of March the lac resin exudation is complete, and the female insects within are glued down by it to the tree. The oval body of the insect becomes of a deep red color; if at this stage a little piece of the lac incrustation a twig is broken off, the insect is perceived, as a little bag of red liquid (which yields the dye), and the place where the wood of the twig has been punctured bears a snow-white mark, as if the place had been touched with a point of chalk. I have removed an entire piece of lac incrustation from the twig, and observed the bark underneath covered with these little white dots, one in every cell and one under every insect; under the microscope they clearly appear to be specks of a semi-crystalline saline efflorescence, at the place punctured by the insect. The proper stage to collect the lac (if intended to produce dye) is when the insect is in the stage of being like a soft red sac. At a later stage it lays its eggs under its body, which is glued down by the resin; when therefore the eggs are hatched, they have no means of egress save by eating through the body of the mother, which they

do, feeding the while on the red coloring matter contained in her body which is thus consumed. When the young insects have regularly eaten through the mother's body (who of course dies under the operation) they pierce the resinous coating and escape. This occurs about the month of June, as soon as the first rain clouds gather, and the lac which is collected after this yields very little coloring matter. Two gatherings are usual however, one about March and one in October, or rather later, up country.

Commercially the best lac comes from Siam, its superiority appears to consist in the uniformity and thickness of the incrustation, which completely covers the twig. Most of the Indian specimens are scanty and irregular. When the lac is first gathered, it is picked off the twigs with the insects and all on it; in this state it is called "kacha" or "khām lākḥ;" this lac is treated with water, and thus the coloring matter is extracted. By this process the concretions of lac get broken up into grains or small fragments, and this forms the "lākḥ dānā," or seed lac; in this state it contains no coloring matter beyond what is indigenous to the resin.

The third or clarified kind of lac is called "chapra lākḥ," or shell lac ("chapra," a shell). This is prepared by taking a quantity of the seed lac in a cloth, made up in the form of an oblong bag: two men each holding an end of the bag, extend it over a gentle charcoal fire by which process the lac melts, when quite fluid each man twists the bag so as to force out the melted substance through the pores of the cloth, and allow it to drop upon pieces of the smooth stem of the plantain (*Musa paradisaica*) placed beneath. The glossy nature of this is such that the lac falling on it spreads out in a thin layer without adhering. Sometimes the seed lac is merely melted into lump lac, which is used to make bracelets of.

The chemical constituents of the different kinds of lac from the analyses of Dr. JOHN,

UNVERDORBBEN, and HATCHETT, appear to be as follows:—

"Stick lac," i. e., lac on the twigs just in the state in which it is found, contains—

1. An odörons resin, soluble in alcohol and ether.
2. A resin, insoluble in ether.
3. A bitter balsamic resin.
4. Acid of the lac (laccic acid).
5. Dun yellow extract.
6. Coloring matter, analogous to that of cochineal.
7. A fatty matter like wax.
8. Some salts and earth.

UNVERDORBBEN classified the resins produced in lac, besides the coloring matters and laccic acid, &c., thus:—

1. A resin, soluble in ether and alcohol.
2. A resin, insoluble in ether, and soluble in alcohol.
3. A resinous body, little soluble in cold alcohol.
4. A crystallizable resin.
5. An uncrystallizable resin, soluble in ether and alcohol but not in petroleum (naptha?).

Seed lac, "lakh dāná," contains (by MR. HATCHETT'S analysis) in 100 parts.

Resin,	68.0
Coloring matter,	10.0
Wax,	6.0
Gluten,	5.5
Foreign substances,	6.5
Loss,	4.0
	100.0

DR. JOHN'S analysis gives very similar results, save that in foreign substances he notices 1.0 of salts of potash and lime, to which probably the white spots on the bark under the incrustations, which were previously noticed, may be due.

Shell lac, "chapra." MR. HATCHETT'S analysis gives—

Resin,	90.5
Coloring matter,	0.5
Wax,	4.0
Gluten,	2.8
Loss,	1.8
	99.6

Lac resin can be procured pure by solution in alcohol: it makes an excellent varnish.

It is soluble in dilute hydrochloric and acetic but not in sulphuric acid.

"It has a great tendency," says DR. URE, "to combine with salefiable bases: as with caustic potash which it deprives of its alkaline taste.

This solution, which is of a dark red color, dries into a brilliant transparent reddish-brown mass, which may be re-dissolved both in water and alcohol; by passing chlorine in excess through the dark colored alkaline solution, the lac resin is precipitated in a colorless state. When this is dried it gives an excellent varnish particularly with the addition of mastic and a little turpentine."*

Lac burns with a pleasant odour—it is used to make sealing wax, and especially to form when mixed, with sulphur and various colored powders, those sticks of color, ("batti,") used by the turners (kharātī) to color their turned wares, producing that beautiful glossy lacquer which is so much admired, and which gained a medal at the International Exhibition of 1862. The native carpenters make a solution of the crude lac as it is, in native spirits, thus producing a strong colored varnish which they use instead of paint, for house wood-work, &c. In some districts *e. g.*, Jhang, the lac, whether crude or refined, is called "chapra," being regarded as the source of chapra lac, and therefore called so. MAJOR POLLOCK in his report on Dera Ghāzī Khān states that 80 maunds are annually imported from Jhang to Dera Ghāzī Khān.

The following specimens of lac were exhibited.

750.—[4050]. Raw or "kucha lakh," from the bér tree. Delhi.

751.—[4132]. Lac on the bér tree, (*Zizyphus jujuba*), exhibited from Kangra, where it grows at Haripúr and Núrúp.

Specimens were also sent from
 Hushyarpúr (4079).
 Lahore (4181).
 Gujrat (4141).
 Jhilm (1461).
 Kapúthalla (4173).

752.—[2507]. Lac on the “dhāk” from Jalandbar and Kapurthalla.

The leaves of the sample of dhāk branches were covered with a blackish dust-like soot, which had a slightly sticky feel, I could not discover the nature of it by the microscope, under which it presented the appearance of a surface of confused blackish particles placed without any order or system.

The following extract was communicated by the REV. J. S. WOODSIDE of Kapurthalla relative to the lac insect.

“About three years and a half ago, or in October 1860, (I believe it was) the Rajah’s Oudh Agent sent up a man from Ikanna with about three maunds of the lac, containing the insect in its transition state from the chrysalis into the working animal. The Oudh man remained some 18 months at Phugwara and instructed the man now in charge in the science of lac cultivation. He says they took the lac from the vessel in which it came, put it into detached portions, tied up in little bundles of grass (somewhat resembling the rush butterfly cages we used to make in Ireland). These bundles were tied to the larger branches of the dhāk tree, and as the insect appeared it found its way out from the bundle on to the branch and soon made its way up the smaller branches where it commenced its operations. This was in November. There seems therefore to be *two seasons* for its labors, the cold season and the rainy season, the one commencing in November and the other in June. The November crop seems complete in February, and the June crop in September. It is not gathered however till the insect leaves it for the succeeding season. The insect has no wings (so my informant tells me) * but it is carried by the wind from tree to tree. It is also carried by insects and birds, to whose feet it adheres, and thus soon spreads over an entire forest. At first it was placed on 5 or 6 trees at Phugwara. Now it possesses over 100, and is likely to spread very extensively ere long. This last crop was 1½ maunds. The insect is indigenous to the Punjab. It is found on the pipal, the bar (banyan), and the bér, &c. A man tells me that a single tree in his village (a bar I believe) yielded Rs. 12 worth of lac the last season.”

753.—[]. Lac of the pipal (*Ficus religiosa*) from Rohtak. LOCAL EXHIBITION COMMITTEE.

It is probable also that several of the rough lac samples of other districts are from pipal trees; in

the upper parts of the province the “bér” lac appears to be the commonest.

754.—[]. “Lákh dāná,” seed lac. This is exhibited from Lahore (No. 4115 and 18), Ambálla (No. 4360), and Delhi.

755.—[]. Shell lac “chapra lákh,” is exhibited from Delhi (No. 4051), Lahore (4114), Gujrat (4142), Dera Ghází Khán (4613).

LAC DYE.

756.—[4937]. Lac dye, exhibited in a liquid form. MUNICIPAL COMMITTEE.
Delhi.

757.—[4469]. Lac dye, “kirmzi.”
Ludhiana. Ludhiana. BILLU MAL.

This dye is obtained from the lac previously described, by treating the crushed lac with water to dissolve the coloring matter; as before observed, it is best that the lac should be gathered when the insect is within the lac concretions as a small oval body consisting apparently of nothing but a soft red substance nearly liquid. If the lac is not gathered till after the insect has escaped from its resinous envelope, the quantity of coloring matter obtainable is very small.

The dyes exhibited are liquid, they are much used for dyeing silk; but very seldom, on account of the expense, for cotton. This coloring matter is used also in preparing the red leather of Nárpúr, and other places.

The lac dye of commerce is prepared by evaporating the colored tincture to dryness, when the residue is formed into little cakes, two inches square and half an inch thick; these are of various qualities and are marked with different letters by which the quality is recognized. By the analysis by DR. JOHN, one of these cakes yielded in 100 parts, coloring matter 50, resin 25, solid matter consisting of alumina, plaster, chalk and sand, 22.

The cakes when prepared for dyeing are dissolved in dilute muriatic acid, and tin is the mordant. The lac is used to give a scarlet dye.

DR. MCLEOD, of Madras, as quoted by DR. URE, states that he prepared a superior lac dye, by digesting stick lac (crude lac) in the cold, in a slightly alkaline decoction of the leaves of *Memecylon tinctorium* (*M. edule*, Roxb.) (called kurpa in Bombay), the solution being applied to woollen cloth, after preparation with a mordant formed of a saturated solution of tin in muriatic acid, produced a brilliant scarlet dye.

* The males have wings and not the females: the males are however rare.—[ED.]

MACCULLOCH mentions that in 1853 the imports of lac to England amounted to 1,200,000 lbs.

COCHINEAL.

Besides the *Coccus lacca* just described, there are several other species yielding red coloring matters of more or less brilliancy and value. *Coccus ilicis* is found on the *Quercus conifera*, or Kermes oak; *Coccus polonicus*, form the scarlet grains of Poland; and cochineal is the *Coccus cacti*, which feeds on the *Opuntia cochinillifera*, (*Cactus cochinillifera*, Linn). Kermes was known to the ancients at a very remote date. It is mentioned by Herodotus, and often alluded to by Pliny; and is the "Tola" of the Hebrew Scriptures, which word signifies "worm." Like Kermes the name gave rise to the term "vermillion," "vermeil," which is now applied only to red lead, minium, and Cinabar. It is remarkable that in all these species the female insect is the color producer, and that the females are very numerous in proportion to the males.

A species of Kermes has been stated to be indigenous to India; but this may be only the mistake of translating "kirmiz," and "krimsi" now applied to lac dye (and also to cochineal) as "Kermes" the *Coccus ilicis*; &c.; but there has been an indigenous species of cochineal no doubt, for in the Jálándhar Doab, there was in the Sikh times a species of cactus so abundant and rapid growing, as to become a nuisance and rewards were offered for its extermination, which however were rendered unnecessary shortly after, as a large number of insects of some kind of *coccus* appeared, and soon effected the destruction of the plant, which is now only occasionally to be met with.

MR. TAYLOR communicates the following information from Jálándhar:—

"From enquires I have made in this district I find that the common prickly pear* was very abundant,

in Jálándhar and some neighbouring districts. In 1849-50, &c., an insect appeared which attacked the plant and destroyed it completely in the course of a year. The natives describe the insect as about the size of a flea, and state that when squeezed it became scarlet, and that the plant itself when attacked soon became of a scarlet color. They say that the cloth dyers collected them in large quantities, and extracted a brilliant color from it. After the plants had been destroyed the insects themselves disappeared and have only occasionally been seen since. The plant is found in small patches at Rahoon, Kártarpúr and Kapúrhalla, but does not exist in any other part of the Jálándhar district. I am informed it is making slight head way however, but no appearance of the insect can be traced."

In the genuine cochineal the female is much larger than the male. The larval stage in both sexes does not last more than 13 days, that of the pupa 15. The male does not live more than a month. As soon as born he seeks the female and when impregnation is accomplished he dies. The female lives a month longer, during which period her abdomen becomes much enlarged. When the period for laying her eggs arrives, she fixes herself to the plant: the eggs adhere to the under surface of the body, and so are hardly visible; as the eggs are discharged the body shrinks, thus affording a cavity under it in which the eggs rest. The eggs are from 250 to 300 in number, united into a narrow band: they are oval and of an intense red color, and covered with a farinaceous secretion, they are hatched in a few days, and like the lac insects, issue though the dried up skin of the dead mother.*

The good cochineal which was exhibited, and which yields the beautiful dye for silk, is imported, and comes *vid* Bombay and Calcutta; some of it appears to come *vid* Bukhára, whence it first goes by the Afghan traders from Sindh, Karáchi and Bombay, and then is brought into the Punjab through the Peshawar passes by Kabúli merchants; but no doubt the greater proportion is imported

* The plant *Opuntia vulgaris*, nat. ord., *Cactaceae* D.C. It is common in America, where a species of cochineal insect lives on it.

* (MOQUIN TANDON, *Elements of Medical Zoology*, p. 27.)

direct from Bombay and Calcutta; it finds its way into Kashmír partly by the Bukhára trade, but also from Amritsar. It is almost exclusively used in dyeing silk.

Cochineal is found in Central America, Mexico, &c., and has of late been much cultivated in the Canary islands, from which in 1856, no less than 1,511,617 lbs. were exported. Cochineal is both wild and cultivated.*

"The insects," writes MACCULLOCH (Commercial Dictionary) "of which there are about 70,000 to the lb., are detached from the plants on which they feed by a blunt knife; they are dipped in boiling water to kill them, and then dried in the sun." They are imported in bags holding about 200lbs. each; they do not deteriorate by keeping. It may be added that the imports of cochineal into Great Britain is for 1856 (the latest year for which data are available here) amounted to 18,123 cwt., the real value of which was estimated at £391,661. In the London price lists for June 1864, the price of good cochineal ranges from 3s. 3d. to 4s. 4d. the lb.

The coloring matter is due to a peculiar principle, termed carminium or cochineal. This is soluble in alcohol. Acids turn the solution orange red, alkalies to violet. The various "lakes" of artists' colormen are prepared by mixing cochineal solution with re-

* It has been also introduced into Spain and Algiers. The impregnated females or ones full of eggs have been carried on little pieces of cactus from the original place to the new one. Indeed thus the principal "nopaleries," or cochineal gardens are formed—1st, the cactus trees are planted in rows about a yard apart, protected only by a high hedge from wild beasts and violent winds—the egg-bearing females are collected from the woods and placed in little nests of cocoa-nut fibre or other material, and the eggs soon hatch, the insects then emerge and crawl all over the nopal or cactus plants, where they soon become naturalized: they require protection of mats from rain and excessive heat.

† BRANDE, Dict. of Sciences.

cently precipitated aluminous earth with which it combines, giving a beautiful crimson precipitate. The "carmine lake" is heightened in its color by an acid salt, such as bitartrate of potash; muriatic acid makes cochineal a brilliant scarlet. As a dye in Europe it is fixed by tin mordant and heightened in color by supertartrate of potash. In this country alum is used as a mordant, and gives the crimson dye. In order to dye scarlet, some yellow dye, such as "harsinghar," is employed along with it. (See Class of Dyes.)

758.—[4573]. Imported cochineal.
Lahore. GHULAM MAHBUB SUB-

HANI.

759.—[4659]. Cochineal, imported
Peshawur. from Bukhára.

Whence it was imported from Bombay; value, Rs. 7 a seer.

760.—[2508]. Cochineal (imported)
Jalandhar. ed).

761.—[]. "Hardwári peori," or
Indian yellow. LAHORE BAZAR.

This is the dried deposit precipitated from the urine of cows that have been fed on the leaves of the mango (*Mangifera indica*).

It consists principally of magnesia and "purreic acid," as it has been called by SIR R. KANE. On treating a solution with weak muriatic acid, after evaporation, yellow scaly crystals of purreic acid are obtained.

This substance is usually met with in the bazars in lumps, called "hardwári peori,"—what is called "wilayiti peori" is chrome yellow in lumps (chrome of lead). Hardwári indicates the locality where it is obtained. I am told that a dye made of the Harsinggar is sold under the same name.

CLASS III. PRODUCTS OF THE VEGETABLE KINGDOM USED FOR FOOD.

Division I.—Substances used as food for man or cattle.

THE collection illustrative of this important section was very large, but as the jury remarked, consisted to a certain extent of grains very similar in quality and general appearance, although they were obtained from different districts.

Now the general features of the majority of districts being so much the same, as far as composition of the soil is concerned, it is but reasonable to expect that the produce in a majority of them should be similar, the difference being more in the amount of produce in a given area, and in the size and fullness of ear than in the nature of the grain itself.

There are, however, certain marked divisions of the province, dependent on physical peculiarities of geographical situation and climate, which exhibit diversities of produce, and these divisions are further noticeable from the change of nomenclature, which as we pass from one to the other, we cannot fail to observe both in the grains themselves, in the soils which produce them, and in the implements of husbandry and irrigation by the aid of which they are cultivated.

In reviewing the agricultural produce of the whole province, from the rocks and snows of the far distant Spiti and the fruitful valleys of Kashmir, to the arid plains of Múltán, and the river banks of the Deraját, the conditions of cultivation are so various, that it will materially add to the interest of this class, as well as illustrate the specimens contained both in it and in some of the subsequent ones, if I lay before the reader a

brief sketch, descriptive of the various kinds of culturable soil, both in the hills and in the plains,—of the means of irrigation,—the principles on which agriculture is conducted,—and of the characteristics of the agricultural population of the Punjab.

In order to do this, I shall endeavour briefly to consider the following points:—

First, The soils,—including such information as we possess regarding systems of rotation, manuring, &c; *Secondly*, The means of irrigation adopted; *Thirdly*, The classes of persons who work the soil, as these from their habits and peculiarities will be found to exercise an important influence on the productiveness of the lands under their treatment; *Fourthly*, The method of treating and cultivating the various crops; and, *Fifthly*, The produce itself, as to its quantity, quality, its cost, and the profits it yields to the agriculturist.

The consideration of the implements of husbandry in use in the Punjab would be here out of place, as there is a special class in Section C. assigned to models and specimens illustrating the subject, and to this class I would refer the reader for information.

I. SOILS.

I have already (at p. 123) in a Geological sketch of the province, noticed the different kinds of soil which characterize the districts of the Punjab. I shall, therefore, in this place confine myself to a consideration of them from a purely agricultural point of view.

The classification of soils, as has been already observed, is of a two-fold nature,—either according to the means of irrigation which are at hand, or else according to the character of the soil itself, though not unfrequently the terms in use are the result of a combination or confusion of both together; in some places also, the use of artificial fertilization furnishes a fourth kind of name or distinction.

After perusing a series of statements collected for the Lahore Museum in 1860, descriptive of the agricultural produce of various districts, it is evident that the different nomenclatures of soils have certain limits, or divisions of the province within which they are current.

Some doubt must unquestionably attach to these divisions when it is remembered that the native officers and assistants employed in making out the settlement records often introduce terms which previously had no local currency. Making full allowance for this, however, there is still evidence of a pretty clear partition of terms indicating difference of soil.

First, there are certain hill districts of greater or less elevation, either Himálayan or Sub-Himálayan, like Simla and its States; and intramontane valleys, such as Kangra, Kashmír, Hazára, and Peshawur; and sub-montane, such as the southern margin of the lowest ranges, known as “Dámani-i-koh,” from Bhimbar to Rúpar, or on either slope of the Pabbi range in the Gujrát district, which have names of their own, resulting partly from peculiarities of situation, and partly from difference of race. To these I shall devote a separate notice.

After eliminating these, the rest of the province exhibits three main classes of nomenclature:—*First*, Those districts (like Jhang, Gugaira, Múltán and some others,) whose cultivation is so poor, that were it not for canals, wells, or the banks of a stream, they would have none at all, appear to have very little nomenclature of soils according to

kind. What they have, has almost exclusive reference to *means of irrigation*: this is very natural; if they had no *water*, it would matter little whether clay, sand, or loam formed the staple of their soil, as the average rain-fall is at the utmost not more than 8 or 10 inches, it would bear nothing but jungle; hence the whole attention is drawn to the fact of there being means of irrigation of one kind or another, and the lands are distinguished accordingly; *Second*, The districts in which Punjabi terms are in vogue,—Chamb, Rohi, Dorangí, Dosháhi, Misí, Maira, Tiba, Kalráti, Shor, &c.,—which I shall describe presently: they comprise the Jálándhar, Bari and Ríchnab Doabs, as also the Jach and Sindh Ságur Doabs, in such parts of them as land is distinguished by soil, and not irrigation appellatives; *Third*, The districts in which Hindustáni terms—Khádir Bángar, Rausli, Dákar, Domat, Matyár, Bhúr or Bhor, &c., are recognized: these comprise the Cis-Sultej States, Ambálah division, and the districts of Gúrgaon, Delhi, Hissár Rohtak and Sirsa.

This threefold classification is only general, and no doubt there are districts where either or perhaps all the names are understood; but the distinction is certainly true in the main, judging from the use of the one set of terms or the other in the various districts from which the returns have been received.

The classification of land according to means of irrigation is understood everywhere. Even where terms descriptive of *soil* are employed, any or every class of land may also be described as “*chahi*,” if it is watered by wells; “*abi*,” if by ponds; or “*chalárs*” (to be described hereafter); “*sailábi*,” if by flood and inundation of rivers; *páni mār*, if damaged by drainage floods; and “*baráni*,” if dependent on rain. These names themselves indicate the source of the water of irrigation.

In Múltán and Jhang, and some other districts also, where these irrigation distinctions

have been noticed as the only ones in use, the term *nahri* from ("nahr," a river or canal) is used to signify lands watered by canals; and in Múltán, where cultivation is almost entirely dependent on that system of multitudes of branch canals, which is characteristic of the district,* there are several terms in use having reference to this method of irrigation. In the low tracts of Bajwát in Sealkot, and of Andar in Gúrdaspúr, which are intersected by a regular net-work of streams, the terms "kúli," from kúl, a water-course, and "pail," a rich kind of loam, are used to signify lands under this species of irrigation.

II. We now come to the "Punjabi series" of soils.

The plain districts of the Punjab are subdivisions of Doabs,† i. e., tracts of country between two rivers. These rivers exercise an influence over the soil to a greater or less extent, on either side of them, and the existence of this influence is proved long after the actual proximity of the stream is passed, by the slight depth at which water is obtained from wells, and by the productiveness of the soil generally.

In the immediate vicinity of the stream, there will be tracts enriched by its alluvial soil, and fertilized by its inundations. The perpetually shifting currents of the Punjab rivers form one of the most remarkable features. Large tracts of land are frequently carried away from one place, while at another part of the stream, a rich deposit of alluvium is thrown up; and it not unfrequently becomes a source of dispute among

the neighbouring landowners, who is to possess the new tract.

As regards the revenue assessment of lands thus thrown up, or the reduction of rent on account of fields washed away, it may be mentioned that there are several methods employed in different parts of the country for ascertaining the value and extent of the alteration required. In the Punjab sometimes the "chak" system is followed, whereby low lands likely to be affected are divided into plots or chaks, and at settlement general rates are fixed for each, which rates are applied to the increment, whenever it occurs; sometimes the system of merely taking up each case as it occurs and reducing or increasing the rent after actual measurement is followed.*

Occasionally, however, the river brings down masses of sand instead of rich soil, and then its effect is the reverse of fertilizing.

Beyond the immediate vicinity of the river, there will be land varying in quality according to circumstances, and including a number of kinds of soils; rohi, dosháhi, &c. Approaching towards the centre of the Doab the influence of the river is less felt, the wells yield water at a greater depth, the poorer class of soils and Baráni tracts become more frequent. In the centre of the several Doabs, west of the old Grand Trunk Road from Firozpúr to Jihlam, and equidistant from the influence of the rivers on either side, is the "bar" tract, generally higher in level than the rest, almost wholly covered with stunted jungle, and good only for grazing grounds for the large herds of cattle and camels, which are reared in such districts. In these parts, what cultivation there is, is dependent on rain, or on wells sunk to a very considerable depth.

* See First Report of the Administration of the Punjab, para. 350, also in Class III., Sub-class (D). Dyes, where further mention of the Múltán canals is made in connection with indigo cultivation. I believe the number of the small canals that formerly existed was reckoned at 257.

† The names of the Doabs are in all instances (excepting the first or Jálándhar Doab) the result of a rude attempt to join the names of the rivers on each side into one word. Thus passing the Jálándhar Doab, between the Sutlej and the Beas, we come to the *Bari Doab*, (*Beas* and *Rávi*). Then between the Rávi and Chenab, the *Richnah Doab*; between the Jihlam and Chenab, is the *Jach Doab*. The last Doab up to the Indus, take its name from that river, and it is called *Sind Sagar*, "the ocean of the Sind" (Indus river).

* In 1858, the loss by diluvion was 51,233 and the gain by alluvion 12,360. In 1859 these figures became 23,071, and 18,502, respectively. A full account of the system of settling cases of alluvion and diluvion will be found in the Financial Commissioner's Circular, No. 81, dated 7th September, at page 362, of the Volume for 1860.

It is now time to describe the various kinds of soils, beginning from the bank of the river, and moving inwards towards the "bar" tract of the Doab.

1. Deposits of moist alluvium extending along the bed of rivers, on which grow tamarisk ("pilchí"), "sarkanda," and the "múnj," (large grasses, of the species *Saccharum*.) are called *bela*.

2. Land periodically inundated by the rise of the river is called *bhet*. It often has an efflorescence of "reh" or "kalar" (sulphate of soda), which renders it less productive. In Lahore and neighbouring districts all the low lands are called "bánjar" or "khachi," and in some places "hetár" and "sailába." In the Leia district, where there is land inundated, the land adjacent to the river is called *sailábi*; this describes land that is *not* periodically inundated itself, but is adjacent to land that is, and is thus constantly moist; 2nd, "kachhí," consists of rich loam over sand, periodically inundated during part of the hot weather and the rains. In the desert the soil is all sand, but where the jhand tree grows it is called "jhandi wali thal," it consists of a mixture of earth and sand, and is good. Manured earth round the villages is called "púwah or puwár."*

3. The next series of soils do not occur in regular order of succession, but they are, in varying degree, good culturable kinds of land, and where they do occur they are in that portion of the Doab which falls more or less within the influence of the river.

The land next beyond the "bhet" soils, and which is beyond the influence of inundations is generically termed in some places "*desya*," and still further inward "*des*," and also *utár*, in contradistinction to *hetár*. In Lahore and Amritsar, "*máhjah*" is a generic term applied to all the higher lands above and beyond the range of inundations, and "*banjar*" to land situated still higher, and

entirely dependent on rain. In the heart of the Richnah Doab, as we recede from the Rávi, the country is saline, hence locally called "kalar," and higher up, "charkari mahál," from the prevalence of wells (chark.)

The first variety of soil is the "*rohi*," which is a stiff loam free from sand, breaks into large clods, and is the finest natural soil. If the calcareous concrete known as "kankar" or "ror," is mixed up with *rohi* land, it is called in the Gujranwalla district, "*kalrathí*;" it is then not so productive, it often occurs in the neighbourhood of barren or "kalri" tracts. In some places the loam is apt to split into wide fissures, and there it is described as "phatwí rohi," there is also a clay soil called "pail," which is a fluvial deposit and found in sub-montane canal irrigated tracts.

In the next four kinds of soil the distinctions are based on the proportions of sand.

Thus, *dúsháhi* or *dosahí* is the same as *rohi*, except that it has some sand in it. *Misti* again has more sand, so that the soil is half and half sand and clay. In "*maira*" soil, the sand predominates over the clay; and "*tíba*" is almost entirely sand, in fact it sometimes occurs as hillocks of pure sand, where it is known as "*réti*;" of these terms, the word *doshahí* literally means "doubtful," that is land about which there can be two (do) opinions (*shái*); it consists of fields of which part is high and sandy and part is good soil.* "*Tibá*" means a hillock, and the term is especially applied to uneven sandy ground of a somewhat high level. Such poor soils as the last, occur in the central or "bar" lands, which are mostly sandy tracts of jungle and grazing grounds. In other districts,

* I have also been told that the word is really *doohái*, and means "partly sandy" (*chhái* = sandy soil). But the above is probably the correct, and has its counterpart in the Hindustani, "*domat*," which has precisely the same signification. WILSON (Glossary of Indian Terms,) gives *domat* as equal to *do matti*, two kinds of earth mixed; he also gives *doshahi*, as meaning land bearing two harvests, but gives no authority for this latter interpretation.

as Gugaira and Shahpūr, these bar tracts are very extensive, and have a peculiar growth of shrubs, grasses and plants, which are full of interest to the botanist, and some of them of value economically.

The following extract from CAPTAIN (now COLONEL) ELPHINSTONE'S Settlement Report on Gugaira, well describes the products of the "bar":—

"The remarkable similarity in the vegetation of arid regions, separated from each other by many degrees of latitude, has often been a subject of notice. Thus not only the physiognomy of the plants which are found in the bar of this district, agrees in a remarkable degree with those said to be met with in the wastes bordering on the Caspian sea; but most of the genera which abound in the southern steppes of Russia, have representative species in this part of the Punjab. I need only mention the *Salsolas*, *Salicornias*, and *Suedas*, which cover every patch of saline land, and are largely used for the manufacture of saji, or impure carbonate of soda. The kurreel (*Capparis aphylla*), the jhān (*Tamarix indica*), the furāsh (*Tamarix orientalis*), and the hēr, (*Zizyphus vulgaris*), which compose almost the whole tree vegetation of the bar, have analogous species on the shores of the Black sea and the banks of the Volga. The same resemblance may be traced in the herbaceous vegetation, which here chiefly consists of *Peganum*, *Alhagi maurorum* (gewassa of the natives), which forms the chief food of the camel, and of various chenopodaceous plants, with grasses of the usual species met with in the North of India. The khaskhas (*Anatherium muricatum*) abounds on the banks of the rivers, and is exported in large quantities to Mūltān and Lahore; and the *Saccharum moonja*, or "surr," covers immense tracts of inundated lands, and forms the chief difficulty of the agriculturist, as it rapidly encroaches on the cultivation. The useful ropes made from this grass are well known; and here I may observe, that DR. ROYLE in his work on the fibres of India, states, on what must have been erroneous information, that cordage is made out of the leaf of this plant. The sheathing petiole is the only portion used: the leaf itself is brittle and is invariably rejected by the native manufacturers."*

The names above enumerated, describe all the principal varieties of soil, but in passing over a district, we are sure to come upon

tracts of country which are affected in a peculiar manner by some local cause—lands, which if that particular local influence were absent, would in their nature fall under one or other of the ordinary denominations of soil. When these influencing causes are present, the quality of the soil in an agricultural point of view is changed, and accordingly it receives a new name.

Where there are low tracts of country, and which owing to their depression receive the water that runs off from the surrounding higher lands, and in which also during the rainy season the water lies because the drainage channels are insufficient to carry it all off, such tracts are called "chamb." This lying of the water causes the soil to be heavy and black, or dark in color.

If the low tract where the water lies in this manner happens to be by nature rohi land, then it is called "chamb rohi," and yields good crops of rice and gram. If in a high tract the soil has indications of saline efflorescence, it is called "chitta rohi," from its white color, the yield of wheat is often good notwithstanding.

If the chamb tract be upon "maira," or "tibba" soil, it forms unproductive hard jungle, which bears little else than grasses, such as khaskhas, dab, the leafless caper (*Capparis aphylla*), the jāl (*Salvadora*), and such like jungle produce, this is called "banjar" or "chamb banjar." The name banjar is also given to any hard barren tract, and also land allowed to lie "fallow" is described as banjar.

These "banjar" tracts are subdivided into different kinds. "Kalr" is that which produces nothing but grass, which springs up only during the rains; it is not arable and is a little impregnated with saline matters.

"Shor" is a kind of barren land, which swells after rain and yields "reh," an efflorescence which consists principally of sulphate of soda, and is fatal to the productiveness of any soil. A third class of banjar land, called *utar*, is a hard level plain

* A very striking account of the bar tract is given in the First Administration Report of the Punjab, para 6.



perfectly unproductive, which has a hollow sound to the tread.

Goera or *nyáin*, is not properly speaking a kind of soil. It is a term applied only to lands in the vicinity of wells and villages, which are abundantly irrigated and manured, which is the great distinction. This is the most productive soil, and on it are planted the valuable or "zabtí" crops, sugar-cane, cotton, tobacco, poppy, &c. Actual desert soil is called "thal." MAJOR-GENERAL CLARKE mentions that in Gujranwalla the tract of country along the river on which the villages are mostly situated, is called generically "kandi." In Shahpúr, where the old bank of the river runs down the Doab, the land is called "nukka," while in other places, land situated in such ridges are described as "dhaya."

In the Jhilm district manured land is called "hail." "Mera," is good land; "las," somewhat inferior; and "rukr," is bad soil.*

These are the principal names for soils of the "Punjabi" class, but the list does not profess to be exhaustive, there are no doubt many other terms in local use, probably varying from pergunah to pergunah, and even from village to village, but such minutiae cannot be entered on in a general sketch like the present.

III. I pass on to the class of "Cis-Sutlej" nomenclature. This is more or less that of Hindústán. This division of soils has been very clearly described by MR. WYN-YARD, in his Report on the Settlement of Ambálah, to which I am much indebted for information on the subject.

The two great divisions of land are *khádir* and *bángar*. (Not to be confounded with the sterile "banjar" soils of the Punjabi series). *Khádir* are low lands that owe their depression to having once been the beds of rivers, or levelled in some way by the influence of river action. *Khádir* would be equivalent to "bent" in the foregoing series.

The other term, *bángar*, includes the higher lands, answering to the generic terms "des" and "máhjah" in the 2nd series. In this tract the wells require to be sunk deep. The water is met with at from 30 to 60 feet, and there is abundant.

In short, these terms are descriptive rather of tracts of country according to situation, &c., than kinds of soils.

The *kinds of soils* into which they are sub-divided are as follows:—

"*Nyái*" is rich land near villages, subject to constant artificial irrigation, and generally fertilized by manure like the "*goera*" of the other series.

"*Rausli*," is a light loam producing all crops, except rice. It is soft and easily worked, consisting of clay and sand; it is mostly like, though superior to the "*dosháhi*" in the Punjabi series. Heavy clay land where the water lies, and which is good for rice and gram, is called *dákar*, answering to *chamb rohi*. *Rákar* is bad *dákar*, which will only grow rice.

"*Bhúr*," answering to "*maira*," is a light sandy soil, the better kinds of it produce bájra, moth, másh and jowár. Low lands like *chamb*, that receive the drainage of neighbouring uplands, and cannot carry it off so that it lies, are called "*choil*." They are unproductive for want of drainage. High tracts from which the water drains off quickly, are called *magra* and *thalli*.

Of the regular Hindustáni terms, "*mat-yár*" is the equivalent of "*rohi*," above described; *misán* of "*misí*," and "*domat*" of "*dosháhi*."

IV. I now come to the nomenclatures of the hill districts, including both hills and intramontane valleys. With regard to these the names and distinctions of soils are few, and in many districts not recognized at all; nor is this wonderful when we consider the nature of the country, how for the purposes of cultivation any site has to be seized on, where a level field can be constructed, and irrigation is available.

* BRANDRETH'S Settlement Report of the Jhilm district.

In the Kangra district the main distinctions appear to be, in the fact of one harvest or two being yielded: the first land is *do-fasli*, and the best of that again is called "*bilúchi*," "*asli*," or "*larhi*," which COLONEL TREMENHEERE says, may be translated "homestead."

The second quality of *do-fasli* land is called "*dalanúr behaoli*." The third kind of land is *ek-fasli*, that is, land that only bears one harvest; while such land as is often allowed to lie fallow, is called "*bahun banjar*." Irrigated land is distinguished as "*kúli*," from "*kúla*," a water-course, unirrigated, as "*utar*," (or upper land).*

In the district of Bunnoo, the terms in use are distinguished by the soil according to its irrigation by canals or other water-courses, and also by its capacity for producing one or two harvests. *Nahri* or *chahi* (land watered by canal or well) is here called "*tandoi*." *Báraní* land irrigated by rain is called "*wacholi*." Desert land or *thal*, is called "*aumá*."

With regard to the Kuhát district, the Deputy Commissioner, CAPTAIN SHORTT, has communicated the following information:—

The best land is called "*bárá*," that which is near the villages, like the *goera* or *nyáin*. If manured it yields two harvests.

The second quality of land is called "*ek-fasli*." It is not manured, and yields, as its name implies, only one harvest in a year.

The third quality is distinguished by the name "*shand*," this is allowed to lie fallow for two harvests, and is then cultivated only for the *rábí*.

The fourth kind is "*math*," it is a good quality of land, and is retentive of moisture, and will, if manured, yield two harvests in the year.

The fifth kind is "*regi*," that is mixed with sand, or adjacent to the bed of a nallah or hill stream, "*shelah*," which has washed down quantities of sand.

The sixth class of land is called "*lúrah*," this is of inferior quality; by the passage of water over its surface it becomes furrowed and uneven, "*algad*."

The seventh kind, or "*dág*" land, is also bad, is at a distance from the villages, and is only once cultivated in an interval of three or four years.

An eighth kind is "*dab*," this is good land and is retentive of moisture; it yields with manure two harvests.

"*Tand*" is the ninth kind; is described in the original vernacular paper, as "*chughar*," moist and cool, and retentive of water.

"*Hawár*," is a tenth kind; the word is probably a corruption of "*hamwár*," as it is described as perfectly level, and it produces neither grass nor jungle, and is cultivated only once in two years.

"*Abí*" land, is a distinction also recognized in this district; and lastly, "*lalmi*," is a kind of land of which, however, no particulars are given.

In the Hill states of Simla, I am informed that the difficulties of cultivation generally, and the ignorance of the people, combine to prevent a discrimination of soils; but this is not altogether the case in these submontane districts, which though they have not the peculiar crops and the rigid climate of the higher regions, are yet quite distinct from the districts of the plains. To illustrate this class of district, I extract from MR. MELVILLE's *Ambáláh Report*, an account of *Kotahah*, one of the submontane districts in the *Ambáláh* border of the lower *Himálaya*, and close to *Sirmúr*. Many of the products contained in the collection were derived from thence and from similar States, and these peculiarities therefore deserve notice.* MR. MELVILLE writes:—

* The natives give generic name "*dáman-i-koh*" (Persian) or "*kandi*," to the low hills that form the basis of the higher ranges, and in which such hill States or *Kotahah*, and others are situated.

* These names are on the authority of COL. TREMENHEERE.

"This tract of country is at present bounded on the east and west by the Sirmár territory; on the north-east by the country held by the Pattiala Raja (comprising Pinjore); and on the west and south-west by the plains, which belong partly to the Meer, and partly to the Ramgarheeah Sirdars. In shape this hill tract is more oval than anything else.

"There are two main ranges of hills within its limits; one on the east, the other on the west side, and both running through its extreme length. Between these ranges, there are numberless spurs branching out in all directions. The western range is connected with the plains by numerous ridges sloping down pretty gradually.

"The main ranges are at a considerable elevation above the plains. No great heat is ever experienced in the highest points of them. The eastern side of either range is the most favorable for cultivation, both the land and crops being better than on their western slopes.

"Before proceeding to detail the old revenue system obtaining in these hills, I will give an account of the different soils. There are 1st, 'koolahoo,' or land watered from kools (*i. e.*, small water-courses from a stream, &c.); 2nd, 'obur,' or land dependent on the heavens for moisture—(baránee.) The 'obur' land is divided into three classes:—'Toduh,' 'first kheel,' and 'second kheel.' The Toduh land is that which is built up into hanging fields (a field is here called 'bughuree,' not khet) one piled above the other, very narrow, and universally of very small size. It is known as 'uvul' (first class) and 'doyum' (second class) by the people. The first quality is that which is free from stones, is manured and produces well. The second is dry, stony stuff, not worth much. The koolahoo and toduh lands are always ploughed. The kheel is that land which is broken up on the high slopes of the hills. It is rarely ploughed. It is dug up by a small hoe, called 'kussee.' It lies fallow for a period varying from three to twenty years. Where the hill side is not very steep, the superficies of soil is deeper, because the rain does not wash it away so easily as on the steep sides. In the first case, crops can be grown at lesser intervals; but in the latter case, it is necessary to allow a long interval to elapse, before another sowing can be attempted. The reason of this is that no kheel in such localities is ever broken up without it is covered with jungle. The jungle is cut down and burnt, and the ashes mingled with the soil, and until first wood springs up no attempt is made at cultivation. The method of cultivating the kheel in the rougher parts of the hills, will be subsequently explained. Level land is called 'seer.'"

Of hill districts generally it may be re-

marked that as a rule they produce but little, and almost all Hill states are obliged to import their food. The soil is generally good, though often it is worked with great difficulty on account of the quantity of stones it contains. In all the lower hill regions especially, the formation consists of conglomerates, full of blocks and boulders of the primary strata of the higher hills, and hence the fields are found to be encumbered with masses of granite and slate. The cultivators cannot move these, nor can they remove them by blasting, so the soil has to be turned as it may, the laborer working in and out among the stones. The fields are generally on a sloping place formed into terraces, each one being a little lower than the one above it; each field also is edged with a little embankment, and the water for irrigation being let in upon the upper fields, overflows them and runs down to the next, and so on.

In the upper hills cultivated spots are to be found wherever there is sufficient soil upon the steep hill-side to make it possible; the fields are always ranged in terraces like a flight of steps up the hill side, and are often so narrow as to be literally like a stair-case; in fact these little plots have no connection with the European idea of a field. The edges of the terrace fields are heightened by loose stone dykes, this retains the water for irrigation, while an opening allows the surplus water to run off into the lower fields.

V. Rotation of Crops, Manuring, &c.—

It is perhaps not too much to say that rotation is not practised, if we explain the term rotation to mean the principles on which, having ascertained the requirements in soil constituents of the various kinds of crops, the farmer plants them in such order of succession that when one crop has exhausted the land of one of its elements, another should be planted in its place next year, which does not require that particular nutriment to ensure its growth, and which

moreover, by its own exuvia tends to restore to the soil the particular constituent of which it was deprived by the former crop.

Such a principle is almost unknown: and although there is a succession of crops practised, it is chiefly observed in lands that have been manured, where, in order to make the most of the fertilization effected, the next sowing consists of crops which require rich soil, and the next of those requiring less richness, and so on. For instance, in the Cis-Sutlej States, wheat follows sugar-cane, and cotton, wheat; thus the manuring once laid down for sugar-cane lasts for three years' crops. Otherwise in the Cis-Sutlej States, barley and gram (*Cicer arietinum*) follow rice; tobacco follows cotton; sugar-cane sometimes is grown after maize: this rotation is followed also in other districts.

In Múltán, turnips and "múli" are grown after "jowár" (*Holcus sorghum*) and wheat.

In Hazara, barley for the spring harvest, is followed by maize for the autumn—"moth" (*Phaseolus aconitifolius*) for the autumn by wheat in the spring. Cotton in autumn by maize in spring: "channa" (*gram*) by wheat.

In Gujrát and other districts, wheat, maize, barley and jowár follow in succession. As these are all cereal grains, they cannot relieve the soil much.

But in many districts it constantly happens that year after year, the same crop is sown—fallow being the only rest the land gets.

In the Kangra district, where rice is the important product, a system of rotation which appears almost fanciful, is carefully observed in growing the different kinds of rice.

"Básmati" rice is invariably sown in the finest kinds of soil, after linseed and wheat, and the same variety of rice is never sown two harvests running on the same soil. And MR. BAYLEY remarks that as the varieties of rice are almost innumerable, there is ample room for succession.

On reviewing these practices of rotation there appear, no doubt, some among them that may be beneficial. They are followed because having been once or twice found to answer—they have passed into a custom, but the farmers have no knowledge of the reason of rotations, or how to improve on the system they follow.

Land is often allowed to lie fallow wherever the owner can afford it; sometimes for the whole year, sometimes for one harvest only. In Sealkot ordinary fallow land is called "bahan;" when it has lain fallow for more than a year after an exhausting crop like sugar-cane it is described as "barhyál." Not unfrequently the farmer divides the area of his land in half; and for one year cultivates one half for the spring harvest and the other half for the autumn harvest. Next year after this, the half that was used for the spring is not again cultivated till the autumn of the following year, (lying over two harvests,) and the half that was used for the autumn, lies over the next spring and autumn, and is cultivated again for the spring following; thus each half lies over two harvests before recultivation.

Manuring is much practised in the vicinity of villages, but beyond them only for the best crops, such as sugar-cane, cotton and rice, where grown near wells. Some kinds of crops, as poppy, sugar-cane, maize, &c., require, or greatly benefit by manure. Every village has a place where manure, consisting of ordure and ashes, and every kind of refuse is heaped: sometimes the owners possess separate heaps. The right to a share of the manure is not unfrequently a cause of dispute.

The manure is seldom or never used fresh, it is allowed to accumulate from six months to two years, after which period it is not kept, as it loses its fertilizing property.

Sometimes the manure is put on the land before ploughing and gets mixed in, sometimes it is added after, and sometimes also it is applied by hand labor after the crops

have sprouted, two or three times over, especially where the soil is poor. For the crops of the spring harvest manure is laid down in October; for those of autumn, in May.*

Besides this kind of manure, decayed leaves are esteemed, and worm-eaten wheat is thought excellent. In indigo making districts, the indigo plants after steeping are used as a valuable manure. In the Kangra valley, in the low watered tracts at the foot of the lowest ranges, and in Sealkot and Gujranwalla, along the banks of the Deg, where much rice is grown, chopped straw and offal are largely used as manure.

In the Gujranwalla district, a habit prevails of laying down ashes from brick kilns on the floors of cattle sheds. The ashes protect the cattle from the cold ground during the night, and next morning being carried out with the litter, becomes exceedingly fertilizing as manure.

Very often the stubble of sugar-cane and rice are set fire to, the charred remains being considered very fertilizing.

The sweepings of old brick walls are also spread over the fields. In some places the earth that has crumbled from old mud walls is thought a good manure.†

It would appear that in some parts of the Ambālah division, a practice exists of occasionally growing a coarse kind of millet, sawānk, (*Panicum frumentaceum*), which is ploughed into the soil green as a manure.

In some districts of the Derajāt, the urine of camels is valued as manure.

In the hill districts, manure is of the greatest importance, and land is almost always manured before sowing.

Of Kangra, MR. E. C. BAYLEY, writes:—

"In Kangra the droppings of the flocks of the hill shepherds who bring both sheep and goats to feed in

the lowlands during the winter, are much sought after. I remember a case in which a civil action was brought against a gaddi (sheep farmer), by the owner of a certain field, in which the gaddi had been in the habit of folding his sheep for many years, in order to compel him to continue doing so."

The following extract relating to Kanāwar, is equally applicable to all the hill districts of similar situation.*

"Every cultivator heeps up before his door or under his house the dung of all the sheep and cattle, and mixes these with the dry grass and leaves used for littering the animals. Oak, pine and rhododendron leaves are most used. To this are added the dried capsules of poppies and the shells of walnuts, with refuse chaff (*bhoosa*) when not required as fodder. Indeed this branch of rural economy is well attended to, and these substances having lain during the winter months are found to be well mixed and rotted in spring, when they are applied to the soil both at the time of sowing and after the plants appear above the ground."

II. IRRIGATION.

Is firstly effected by natural causes—rain, rivers, and inundations, &c. In almost every district there are portions which are out of the reach of artificial irrigation, and so are dependent on rain, and whole crops are often lost for want of it; but there are only a few kinds of crops (*e. g.*, gram) that are as a universal rule, left to the care of rain. "Moth," and other inferior pulses, are greatly dependent on rain.

Some crops will not grow without artificial irrigation, such as poppy, tobacco, and sugar-cane: the two latter crops, however, will grow without irrigation in low tracts near principal rivers. This is especially stated to be the case in the Ambālah district.

Rain generally falls twice in the year: in the cold weather it benefits the spring crops; and the regular "barsāt," or rainy season, produces the autumn crop.

Rain falling in *Baisākh*, *Jēth*, and the first half of *Hār* (April, May, or early in June) is

* MELLVILLE'S Hushyarpur Report.

† MAJOR CLARKE gives the following proportion of manure as given to crops per acre:—32 cart loads to wheat; 43 to poppy; 56 to tobacco; 40 to cotton and "makai" (maize); 48 to sugar-cane and turnips; and 22 to mustard.

* Cleghorn. Notes on the Vegetation of the Sutlej Valley, p. 7; also in the Journal of the Agri.-Hort. Soc. of India, Vol. XIII., p. 4.

injurious : but for the last half of *Hār* (June) it is good, and the land becomes "watar," or soft for the plough. After this, moderate rains in *Sāwun* (August and part of July) are good, and also in *Bhādon* (August, September); there is an amusing couplet well known to the agriculturists.

"Je mīn piyā Diwālī,
 Jiya phūs, jiya hālī."

"If showers fall about the time of the Diwālī festival [what matter] whether you are lazy (lit. a 'bundle of sticks') or a real ploughman, [the crops are sure to be equally fine]."

If in *Assūh* (October) falls continue with cold winds, the pulse crops are injured. Rain falling after these crops have ripened, *i. e.*, after 15th *Kartak*, is bad, as it will be so late as to throw back the wheat sowings. Rain in *Maghar* (October and November), injures the ripe "kharif," but helps the "rabī" crops. Rain, except slight showers, in *Phāgan* is bad; it produces the red blight called "kūngi," and also rats.

With regard to the average rain-fall in the Punjab, I can only briefly here notice the valuable information obtained by Mr. E. A. PRINSEP, Settlement Commissioner, who has prepared a map showing the various zones of the Punjab in which the average annual fall of rain is greater or less. An extract from Mr. PRINSEP's letter, No. 233, dated 9th May, 1863, to the Financial Commissioner, was published, together with the Map, in the *Punjab Gazette*. The map contained the positions of no less than 150 stations, tehsils, and other localities, where the fall of rain is registered.

The results deducible from these observations are that the gradation of rain-fall are capable of being ranged into zones, which run parallel to the Himālayas. "It is worthy of remark," writes Mr. PRINSEP, "how singularly the results of neighbouring stations agree one with another, in lines ranging from upwards of 70 inches in the Kangra valley (and even 105 at Dhurmsala), to 10 inches on the east of the Sutlej, 5

inches at Gugaira, and say 1 inch at Múltán, in the Bāri Doab."

In the Bāri Doab the difference of fertility is almost entirely owing to the difference of rain-fall.

Gurdaspūr district has above, 30 inches.

Amritsar,	20
Lahore,	10
Gugaira,	5
Múltán,	1

Of artificial irrigation, the sources are canals, wells, and "jalārs," or "chalārs." I will now briefly describe each.

Canals.—Although the construction of irrigation canals has long been practised by the various native dynasties, yet the finest works of this kind now in existence are owing to the British Government. There are districts, such as Jhang and others, which without the influence of canals and branch canals, would be deserts; although in many of these southern districts, there is nothing in the nature of the soil (excluding the "thals" or sandy desert tracts,) to prevent their being as fertile as the richest Doab. There are some canals still utilized which were cut and worked before the British rule commenced; such are numerous at Múltán,* where the indigo cultivation is almost wholly dependent on them. At present irrigation is effected by branch canals, called "rāj-bahā," leading from the main canals, from these again smaller water-courses, called khāl or khúl lead to the fields to be irrigated. These are superintended by the officers in charge of the various divisions of canals, and their establishments—water-rates being paid by the land-owners.

Wells.—These are of two kinds—"kutcha" or "pucka." Kutcha wells are merely dug in the earth without masonry walls or

* In this district there are no less than fifteen canals, of an aggregate length of 325 miles, the largest of which are from 6 to 7 feet deep, and from 20 to 30 feet wide, and the smallest from 2 to 5 feet deep, and from 6 to 10 feet wide.—*First Report on the Administration of the Punjab.*



casing. In some kinds of soil they do very well, where the clay is strong and tenacious; but in other places, especially in the low khádír lands, they soon fall in. In some districts they are worked by a rude kind of Persian wheel, just as a pukka well is. In others, especially in the Cis-Sutlej districts, the water is raised by means of a lever or balanced pole erected over the well; one arm of the lever carries a large earthen "garha," or vessel holding about six gallons, which is let down into the well and raised again by a person pulling down the other arm of the lever; this apparatus is called a "dhenkli." It is the most laborious and least productive of all methods of irrigation. The men's hands often get cut by lowering and raising the "garha."

In khádír lands the depth before water is reached varies for 6 to 20 feet, but in high bángar lands it is much more, varying from 20 to 60: the water is abundant, but is procured with great labor; the dhenkli is not employed for a very deep well. An apparatus called the "lao charsa," or "rope and bucket" is also in vogue in raising well water: it consists of a large leathern bucket, "charsa," made of the hide of an entire bullock, which is attached to a rope, "lao;" this descends into the well over a small broad edged wheel, which works between the prongs of a forked pole—a branch of a tree fixed into the soil at the mouth of the well. This is commonly used in the Ambáláh division, and though it is everywhere to be seen (worked by hand) at wells whence water is obtained for domestic purposes, it is little, or at all used in the Púñjab proper for irrigation. The "lao charsa" in the Cis-Sutlej is worked by bullocks. MR. WYN-YARD describes it as follows*:

"Two pairs of bullocks are employed to each charsa a day. Wells are sometimes worked all day and all night. The labor at these wells is so valua-

ble, that in the Thaneysur district, a bullock shares even with a man in the produce of a shared field: thus, if a field belongs to two men, and one has two bullocks he gets three shares, a man with four bullocks gets five shares. The yield in this watered bángar land, is greater than in the watered khádír lands. The action of the river on khádír lands appears to weaken the land by the sand which it deposits."

Pukka wells are those which have an internal wall of masonry, and a pukka coping; sometimes this is expanded into a chabutra or flat terrace, on which the villagers sit, when they gather together for a sale or any discussion, or to rest after the day's labor and smoke their "hukas."

A notice of the native method of sinking wells belongs to the Engineering Department, and will be found under SECTION C.

Pukka wells are usually worked by the "harth," or Persian wheel. A broad edged lantern wheel whose axis lies horizontally over the centre of the well's mouth, carries on its broad edge a long belt of "moonj" rope, made like a rope ladder, the ends of which joined in an endless band reach below the surface of the water. To this at every step of the rope ladder, an earthen pot called "tind" is fixed. As the wheel revolves, the large rope belt descends into the water with its pots, the pots become filled with water, and are drawn up: as they reach the top of the wheel, they are by the revolution of the wheel inverted, and their contents poured out into a trough, which is ready to receive them, and which leads to the water-course of the fields to be irrigated. The wheel bearing the belt and waterpots is caused to revolve by having on the same axle another wheel parallel to it, and cogged in one side, the teeth of which work into the cogs of another vertical lantern wheel, whose axis again rests in a bar supported between two upright brick or wood pillars at one side of the well's mouth; this vertical wheel is turned by a pair of oxen yoked to a pole, which is fixed into the axis of the wheel in question. The oxen by walking round and

* Settlement Report Ambáláh District, p. 371.

round on a tramway drag the pole with them, and cause the whole apparatus to turn.*

Sometimes over large wells there are two sets of wheels bearing the belt and pots as described, and placed parallel to each other. The well is then called "domalah," or in Punjabi dohartha, or do-chúthi. The single wheel well is called "ek-hartha."

These wells are often the joint property of several owners, who take it in turns to work them.

A "well" when spoken of by a native agriculturist, means not only the well but the land to which it is attached also.

In the Jhilm district however the "well" is something quite unlike the deep well of the other districts with its Persian wheel. It consists merely of a small pit in the low land by the side of a ravine. Each has only 2 or 3 acres attached to it but the ground is kept highly manured, and tilled like a garden, and all sorts of vegetables are raised; wheat is but little grown except to be cut green, as "khavíd." Tará-mirá is grown on the high earthen banks between the fields, thus utilizing what would otherwise be barren wastes.†

The irrigation of the districts in which brine pits abound, and where the water is not unfrequently brackish, is so peculiar that my sketch of the irrigation system would be incomplete without a reference to it. The following extract describes the wells of pergunah Rewari, in the salt producing district of Gurgaon :—

There are four kinds of water found in the Rewari wells, all of which are used in irrigation; but the produce of each varies.

The *first* is "shirín or mithá," the irrigation from which in common seasons, does not produce such remarkably fine crops as the other kinds; but this is infinitely more than compensated by the fact that, in drought years the produce is certain and abundant.

Second. "Matwállah," or hard water: the land irrigated by which produces very fine crops except in drought years, when they are rather inferior, though still good and certain. Matwállah is composed of a large portion of sweet and a small portion of salt water.

Third. "Malmalla," or brackish water, with which good crops but inferior vegetables are produced, in common years. In drought however both are inferior.

Fourth. "Kharí shor," or very brackish water; this irrigation is said to bear finer and more abundant produce than the others. In a drought, however, the crops utterly fail, from the seed being burnt up in the ground. In the present season land thus irrigated was covered with a coating of salt resembling hoar frost, without a blade of any crop. Should it, however, happen that rainfall shortly after the seed is sown, the noxious quality of the salt is corrected, and that land yields produce. In no season is tobacco or any kind of vegetable grown, nor will man or beast drink of this water.

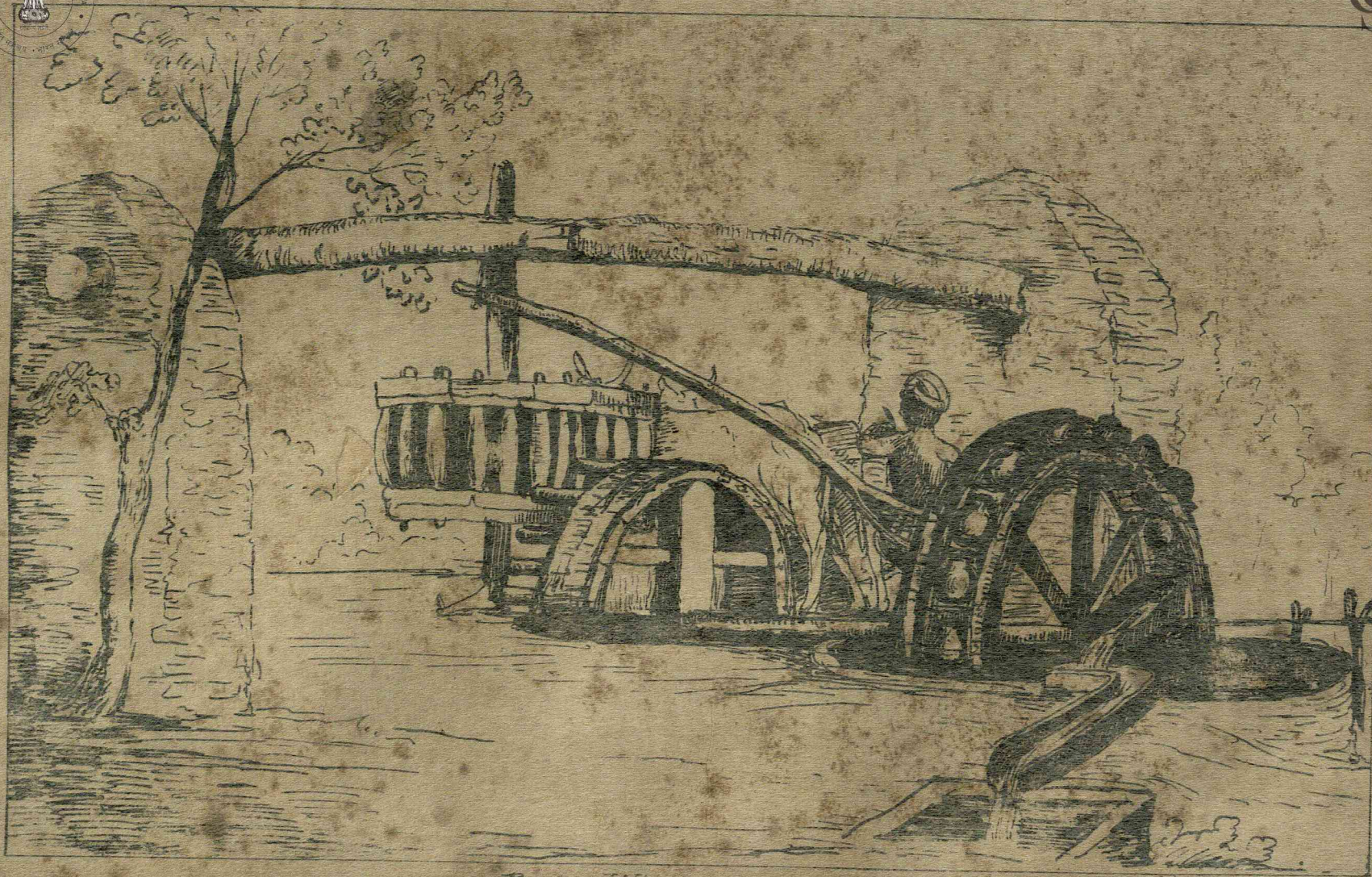
The area watered by a well in the Cis-Sutlej States, is shown in the following statement, deduced from MR. WYNKARD'S Tables :—

Kind of well.	In a day. In acres, roods, poles, &c.	In the season.
	R. P. R. P.	
Pucka well worked by "charsa,"	From 1-15 to 3-5	From 3 to 12½ acres.
Do. do. Persian wheel,	From 0-30 to 2-10	From 3 to 6½ acres.
Kutchra, worked with "dhenkli,"**	From 0-7½ to 1-20	From 1 acre 35 poles, to 3 acres.
Do. Persian wheel,	From 0-15 to 1-35	From 2 to 3 acres.

* I have added an illustration to make this description intelligible.

† BRANDRETH'S Settlement Report, Jhilm.

** The "dhenkli" is seldom used in the Punjab proper, except for the irrigation of rice fields, and in river tracts for melons and tobacco.



Persian Wheel see page 208

In the Ambáláh district, with a Persian wheel, $7\frac{1}{2}$ acres is about the extent which can ordinarily be irrigated in a season. In the Charkari Mahál of Sealkot and Gujranwalla, 20 to even 30 acres will be watered in a season, but then 6 yoke of oxen are employed, and the well works night and day.

MAJOR CLARKE gives the average in the Rechna Doab thus:—A wheel worked night and day, with 6 pair of cattle, waters from three quarters to one acre. "Maira" land takes a larger quantity of water.

I cannot more clearly describe the method of irrigation adopted, than in the words of MAJOR CLARKE. He writes thus:*

"The well used for irrigation is worked by the Persian wheel; it is to be found in all soils from the 'khádir' to the 'bár.' The cost of sinking a well ranges from 50 to 300 rupees,† and is dependent greatly on the depth of the water from the surface. A first rate (kámil) well, has forty acres of land attached to it, and should be worked by eight pairs of bullocks: in general, however, there are not more than four pairs, except in the bár, where every good well has at least six pairs. The condition of a well is almost universally estimated by the number of yokes attached to it, and no well with less than four yokes is considered worth much.

"The arrangements of watering are dependent on the number of shares, each share having a stated period allotted to it, called 'varee.'‡ If there are only three shares in a well, then the 'varee' will extend to eight watches—24 hours: if four shares and upwards, the period allotted to the varee is four watches or 12 hours. The varee of 12 hours is by far the most common, especially in 'bár' estates. In these there are generally 4 'varees,' in the bángar often 6, whilst in the khádir we find 8 and 10 'varees.' In the khádir one yoke of bullocks will work for two watches, consequently 2 yokes will work a varee; whilst in the bár one yoke cannot work more than one watch, so that four yokes are required to work a varee of four watches.

"The amount of land irrigated by a well depends on the nature of the soil, depth of water from the surface, and condition of the well; but most of all on the number of yokes it is worked by. A 'kámil'

well with 8 yokes, worked day and night, will irrigate 40 acres of land. This however cannot be reckoned on with certainty, and I should say 30 acres is the average in ordinary years, whilst in years of scarcity or drought, not more than 20 or 25 acres can be calculated on. In bar land, one yoke is equal to irrigating 5 acres in the year, whilst in the bángar land and khádir it reaches 7 or 8 acres. The soils of the khádir and bángar tracts however absorb more water than that of the bár. Buffaloes are mostly used in the 'bár.' They are also coming into use in the bángar lands, but in the khádir inferior bullocks can do the work. Buffaloes are superior in strength to bullocks; but cannot work in the sun so well. The expenses of irrigation are least in the khádir, and greatest in the bár; in the latter the water is often so far from the surface, that it is by no means uncommon to see two yokes of buffaloes working together at one well."

The last kind of irrigation mentioned was by jhalár (or chalár). It is used only in such localities as exhibit the peculiarities to which this method is adapted.

"A 'chalár,' is merely the Persian wheel of a common well transferred to the bank of a canal, the margin of a jheel, or the high bank of a river. A small pool is excavated immediately below the chalár to collect the water, and afford the wheels a sufficient surface to work upon. As almost the whole expense consists in the wood work, chalárs are constructed in great numbers, and abandoned again without materially affecting the prosperity of the zemindars."

In some places there is a modification of this called a "raota" or "phiraoti," when there is only a wheel fitted with the belt and jars, and a man located on the bank turns the wheel with his foot, tread mill fashion, and aids with his hands also.

III. CLASSES OF CULTIVATORS.

The present survey will by no means admit of anything like an ethnographical essay; but the habits of the different farming classes are so very different, as regards the care and energy exhibited in the processes of agriculture, that I should omit a very important cause influencing the state

* Agriculture of the Rechna Doab. Selections from Correspondence of Government of Punjab. Volume II.

† In many places a well costs more than double this sum.

‡ Equal to the Hindustáni "bari," a turn.

of cultivation and the productiveness of districts, were I to pass this subject over wholly without notice. MR. BRANDRETH justly remarks that the energy of the cultivator has much more to do with success, than the possession of the best soils, and the easiest modes of irrigation.

The following extract will show how large the class of agriculturists is in the Punjab.

"The proportion of agriculturists to total population is 56 per cent. The corresponding percentage in the North Western Provinces is 64. The proportions in both cases should however be greater, than that actually shown. More than half the population is certainly agricultural. It is probable that three-fourths subsist on agriculture, and if the returns had been strictly rendered, according to the prescribed definition,—namely, that all persons deriving any part of their subsistence from the land should be classed as agricultural, then not less than four-fifths of the population would have been returned as agriculturists."*

The most industrious classes are the "Ráíns," "Sainís," "Lubánás," and "Jats." The Ráíns besides their grain crops, are great growers of vegetables—such as melons, pumpkins, and gourds of sorts, "baiṅgan" (*Solanum melongena*), "múli," "ghúyāñ" (*Arum colocasia*), and others. They are diligent, persevering men, and will often succeed in producing on good land, three or four successive crops of vegetables. There is a caste of *Mális* very similar in industry. The Sainís are a class found in sub-montane tracts, whose villages are always in a high state of tillage, as a rule they are great growers of sugar-cane. There is also a race of traders called Lubaná (in some places Brinjara), who settle down as agriculturists on waste tracts, and are known to be very careful and thrifty cultivators. There are

numerous colonies of them along the right bank of the Rávi.

The Jats are conspicuous for their industry, they are not such great vegetable growers as the others; but their well fenced, and well worked fields are always known from the slovenly and ill-cared for lands of Gújars and Bráhmans. The wife of the Jat works cheerfully in the field with him in every kind of agricultural labor; not so the Rájput's wife, who does nothing but spin cotton and cook for the family.

Next to Ráíns, Mális, Sainís and Jats, rank the castes of Syads, Patháns, Banjāras, Bráhmans, Gújars and Rángars, placed in the order of increasing slothfulness, while last and worst is the Rájput. The latter considers ploughing an occupation beneath his dignity, and it is only necessity that drives him to cultivate at all: he will never plough his land himself, as long as he can get any Chamár, or low caste man to do it for him.

In border districts of the North West frontier where hill tribes prevail, agriculture is generally at a discount. The Biluchi tribes are indolent: they sow the seed and take little or no care after it, leaving it to the course of nature, to produce some how or other their yearly crop. At the same time it must be confessed that not a few of the wild tribes who formerly lived as marauders and freebooters, have since the British rule began, settled down to agricultural occupations, and the tendency towards the increase of agriculture is a very marked result of the establishment of British Government. From these considerations it becomes obvious that the productiveness of a given area of land, will very much vary according to the class of people who cultivate it.

A Zemindar who is rich enough to cultivate without the aid of a loan from the "Shahukárs," or money lenders, at sowing time, is likely to be a much more thriving farmer, than others who, as is only too often the case, are dependent on such a loan to

* Indian Records, No. XI. Report on the Census taken on the 1st January, 1855, of the population of the Punjab Territories.



purchase the necessary seed,—and if there is delay, the sowing time passes, and the crop put down out of season is inferior. Unfortunately, these Shahukárs are still an established institution.

Owners of land frequently cultivate themselves with the help of “Kāmas,” or laborers, who receive certain dues in grains, clothes, and money, according to the prevalent district custom. In some districts servants are of two classes—Mulázim and Ghair Mulázim, or Kamín or Sepí. The class of “Mulázim” includes half year servants, (“chah mahidar,”) and “dah mahidar.” The latter often has a break in his service for *Baisák* month till *Hár*; and MAJOR CLARKE says, that his title is derived from this break of service of two months in a year, making him a 10 month (“*dah máh*”) servant. A third kind of servant without a distinguishing title, is employed from 15th of *Hár* to the end of *Chet*. These men are all paid by so much wheat, so much money, together with their shoes, blankets for the cold season, and tobacco—the rates varying for each kind of servant. The *Ghair Mulázim* or Sepí, are a kind of workmen to be found in every village, who work for all, without being the servants (mulázim) of any one in particular. These go with the farmer to sow the field, and do other agricultural duties: their caste and names being descriptive of the proper trade to which they are brought up. There are the Kumbhár (potter); *Tirkhán* (carpenter); the Chûra, or “*Khák-rob*” (scavenger or sweeper); and the *Mochi* (leather maker and cobbler). Besides specific payment for any work they do, they get certain payments and allowance of grains and pice. But the owners often do not cultivate; their land is given out on a “cultivating lease,” as it were, to Paikáshts or cultivators, of other villages who take the produce, giving a share, with something extra as “Biswí” “ser,” or five seers in the maund, as rent or “Malikáná,” to the owner. These cultivators are tenants-at-

will, but there is a curious and somewhat anomalous institution, which if not the creation of the British rule, is at any rate chiefly maintained by our present system. This is a class of hereditary cultivators, persons who at the commencement of our rule were assumed to have the *right* to cultivate certain lands, though they were not the owners. They received fields from the owners, they paid Malikáná like the others, they often did menial services, entered into mutual agreements, even had their fields changed, and yet under the present revenue system *cannot* be turned off as the other class can, on notice of ejection duly given. That such rights (as far as there could be any *rights* properly so called under former native dynasties), did exist in parts of the N. W. Provinces, there can be little doubt; but whether such rights existed in the Punjab and in other parts as an ancient rule, and whether any ancient practice sanctions the adjudication (as at present allowed) of these rights in favor of a tenant of more than 12 continuous years, may reasonably be questioned. It is, however, impossible at this place to extend our argument to the more detailed consideration of this interesting subject, and I would dismiss it with this notice, leaving it to those interested to study the subject *per se*.

IV. METHOD OF SOWING, WEEDING, AND GENERAL TREATMENT OF CROPS.

The great harvests are called universally *Rabí* and *Kharif*, or by the villagers “*Hári*” and “*Sáwáni*,” from the names of the months in which the crops are ripe.

Rabí is the spring harvest; kharif the autumn; but it is not all land that bears two harvests. Land that will, is called “*do-faslí*,” and land that only bears once, “*ek-faslí*,” but there are certain tracts of country where two or even three harvests will be taken off the soil.

The spring crops are the important ones,

for they are sown just at the great rain-fall of the year—the “barsāt” or rainy season—about the month of September, and the crop which has been sustained during its growth by the winter or latter rains is cut at the end of the spring of the year following in the month of Bysākh, and the months following. In the bāngar lands of the Cis-Sutlej States, MR. WINTARD writes, that the rabī crops are not sown where artificial irrigation is not procurable, and that the autumn crops are the staple. The kharif or autumn crops are sown before the rains, and reaped after their close in October and November.

MR. MELVILLE writing from Hushyārpūr says —

“The rabī crop is reared after great labor; the kharif with but little trouble, the latter invariably follows the former, and the ploughings of the rabī are almost sufficient for the kharif also. When the spring crop is cut, the husbandman will wait for a shower in June, plough over his land once or twice, and sow his kharif crop.”

Fallow lands are never turned up for the first crop at kharif; but always begin with a ploughing and sowing for the rabī harvest. The principal crops of the rabī are—wheat, barley, gram, “mattar” (*Vicia*), lentils, tobacco, linseed, (“sarshaf” or “sarson,” “rai,” &c.). The kharif sowings are “jawār,” hājrá (millet), maize, rice, “moth,” “múng,” “māsh,” and other pulses, sugar-cane, and cotton. These are produced by the efficacy of the rains, which occur when they are in full growth. These crops require much moisture, and most of them, except the pulses, get artificial irrigation beside the rain. The land is subjected to repeated ploughings. The number of them depending on the industry and the means of the farmer; but their number seems much to influence the success of the crop. The fields to be sown with the (zabti) best crops, are often ploughed over and over again, ten and twelve times; six times is about the average. The plough seldom goes deeper than 6 inches, while in

England 9 inches depth is considered to give the the best crops.*

Land intended for sugar-cane receives the greatest number. The land intended for this crop is ploughed up as if the land were to be sown for a rabī crop, and then left till *Har*, when the planting is effected.

Annexed is a Table showing the number of ploughings given to each kind of crop.

Crop.	Number of ploughings in <i>rabī</i> land.	Do. <i>duskhāt</i> land.	Do. <i>maire</i> land.	Remarks.
RABI.				
Wheat,	12	11	10	The number of ploughings will vary much with the skill, industry and means of the cultivator.
Gūji (wheat and } barley together), }	7	7	5	
Barley,	5	5	4	
Gram,	2	2	2	
Poppy,	10	9	9	
Tobacco,	9	9	9	
Linseed,	12	12	11	
KHARIF.				
Makai (maize), ..	7	6	6	
Cotton,	5	5	5	
Mustard,	7	7	7	
Sugar-cane,	11 to 27	11	11 to 27	
Chari (jowār grown } as a fodder), }	2	2	2	
Dhān (rice),	4	..	..	
Munji (rice),	5	..	..	
Moth,	..	..	1	
Mūng and } pulses, Māsh, .. }	..	..	2	

It will be observed how much fewer are the kharif ploughings than the rabī, with the single exception of sugar-cane land, which however is no real exception, for this land as before remarked, is prepared at the same time as the rabī lands, but left to lie till the kharif sowing time.

A pair of good bullocks will plough half an acre daily, but weak ones less. Cattle are never kept at work continuously for more than 5 hours in a day, or 2½ at a sugar mill. Generally speaking, there is in “bāngar”

* Sealkote Report, p. 116.

lands about one pair of bullocks to 7 or 8 acres. "Bār" lands, where the wells are deep, take one pair to 5 acres, and buffaloes are there much in use on account of their strength. In the well lands it is said that the animals die off quickly because of the constantly rotatory motion which they undergo at the well. "Khádir" land requires less, and weaker animals will do.* In submontane and hill villages a pair can be purchased for Rs. 16, sufficient for ordinary ploughing purposes.

Land after being ploughed is levelled with a "sohága," called "dáh" in the submontane districts; a flat straight heavy piece of wood dragged over the surface of the field by cattle. Sometimes they are made with teeth, and called "much." Some crops are then sown broad-cast, and after the seed is down the land is twice ploughed over, and the field marked out into beds or divisions for irrigation purposes, the divisions being little banks of earth dividing the field into squares. The exact time for sowing is dependent on considerations of weather, rains, &c., and varies for different crops; the people are also superstitious, and often consult Múllahs and Bráhmans, according as they are Hindús or Mussulmáns, to ascertain favorable omens and times for sowing. Sowing is generally done broad-cast, but in khádir lowland along the banks of rivers, it is effected by the drill: a hollow piece of bamboo is attached to the plough through which seed is dropped, and the ploughing and sowing are thus done at one operation; but this practice is not followed in lands irrigated by wells ("chahi"). Sowing, when broad-cast is performed by the farmer, with the aid of the "Kamínah,"—the Tirkhán, Lohár, and Chamar, &c., who receive certain dues for their work.

Reaping is done by laborers, who are paid either so much per "kanál" of wheat cut, or else so much per diem.

Manuring is done by Chúras (low caste of sweepers), who receive a small due, and the gleanings of the gathered grain.

Cotton is usually sown broad-cast like wheat. Poppy, tobacco, rice, and some other crops, are sown in nursery beds, called "lab," and when the seedlings appear are planted out. Sugar-cane grows from pieces of the cane containing some joints. They are put into furrows made in the soil.

In sowing, the quantity of seed required to one acre is proximately given in the following Table.

Each kind of crop has generally some peculiarity as to its management, or the method of sowing and rearing it, such details will be noticed in the catalogue along with the name of the particular product to which they refer.

Statement of the average quantity of seed required for one acre of land.

Description of crop.	Maunder.	Seers.	Chittaks.	Remarks.
Wheat,	1	10	...	Sailabi land requires less seed than chahi land.
Goji,	1	10	...	
Barley,	1	10	...	
Gram,	...	20	...	
Poppy,	...	...	7	
Linseed,	...	14	...	
Tará mira,	...	15	...	
Moth, mong & mash,	...	2	8	
Munji (rice),	...	12	...	
Chari,	...	20	...	
Makai (Indian corn),	...	9	...	
Cotton,	...	8	...	
Mustard,	...	3	...	
Turnip,	...	2	8	

When the crop is sown, the number of waterings that it receives greatly depends on the district, the fall of rain, and other natural and local circumstances.

Hand-hoeing and weeding are often given to crops. The operation is called "godí," and is effected by a flat kind of shovel or hand-hoe, "rambha," very like the "kharpa" of Hindústán; but much depends on the class of cultivators, and these operations are little

* MAJOR CLARKE'S "Agriculture of the Rechna Doab."

attended to by the lazier castes of agriculturists before-mentioned. In the Cis-Sutlej districts, weeding appears to be much more attended to than in the others. In Thanesar, it is stated that sugar-cane is weeded 10 times; the poppy 7; tobacco 5; cotton 4; and maize 3. Sugar-cane, cotton, Indian corn and tobacco, and even rice require manuring.

The following statement indicating the ploughings, waterings, sowing time and reaping time of the various crops, has been compiled from the valuable Tables given by MAJOR CLARKE, in his account of the Rechna Doab Agriculture; the list applies directly to the Gujranwalla district, but gives a good general idea of the practice and results of the various operations of agriculture in other similarly situated districts of the Punjab proper.

RABI.

Kind of crop.	No. of ploughing.	No. of waterings.	No. of hand-hoeings.	When sown.	When reaped.
Wheat, ...	4 to 8	4 to 8	None.	Rabi, Kartik and Maghar.	Bysakh.
Barley, ..	4 to 8	4 to 8	Ditto.	Ditto.	Chet.
Goji, ...	4 to 8	4 to 8	Ditto.	Ditto.	Bysakh.
Gram, ...	2	None	Ditto.	Bhadon.	Bysakh.
Flax or linseed,	2	Sown in Sallabi.	Ditto.	Assuh.	Bysakh.
Mustard,	8	3 to 4	1	Assuh.	Chet.
China, ...	6 Rabi 4 Kharif	10 to 16	None.	Phagan and Sawan.	Bysakh, Kartik or Maghar.
Kangni,	5, 6 to 7	5 to 6	1	Chet, Sawan and Bhadon.	Bhadon, Assuh.
Tobacco,	4 or 5	15	3 to 5	Kartik, transplanted in Magh or Phagan.	Jeth and Har.
Onion, ...	4 to 8	16	3	Planted out in Magh.	Ditto.
Carrot, ...	4 to 6	3 to 4	None.	Assuh.	Chet.
Turnip, ...	5	3 to 5	Ditto.	20th Bhadon to 10th of Assuh.	Maghar to Magh.
Methi and sinji, ...	...	2 to 3	Ditto.	Kartik.	Phagan and Chet.
Poppy, ...	10 or 12	Every 4th or 5th day.	10 or 12	Assuh.	Chet.

It must be borne in mind that the real number of ploughings for some of the above crops is more than appears in the Statement, because no account is taken of the primary ploughings on wheat lands afterwards appropriated to the other crops, which land lies fallow till it is determined what shall be sown.

KHARIF.

Kind of crops.	No of ploughings.	No. of waterings.	No. of hand-hoeings.	When sown.	When reaped.
Sugar-cane, }	14 to 15	16 to 25	4 to 6	Phagan.	Maghar.
Cotton, ...	4 to 6	Uncertain.	4	15th Har to 15th Sawan.	Assuh to end of Maghar.
Maize, ...	3 or 4	6 or 7 in chahi lands.	2	Har.	Assuh or Kartik.
Jawar, ...	3 or 4	3 to 4	For corn once.	Har.	Kartik.
Bajra, ...	2	2 or 3	1	Sawan.	Assuh or Kartik.
Moth, ...	1	None.	None.	Sawan and Bhadon.	Maghar.
Mung, ...	2	Ditto.	Ditto.	Har.	Maghar.
Til, ...	2	Ditto.	Ditto.	Sawan.	Maghar.
Mash, ..	3	Ditto.	Ditto.	Sawan.	Kartik and Maghar.
Rawan, ...	3	Ditto.	Ditto.	Har & later.	Kartik.
Rice, ...	Vide details of cultivation in the sequel under "rice."				
Sawank, ...	2	3 to 4	None.	Har & later.	Bhadon, Assuh and Kartik.
Mustard,	5 to 6	5 to 6	1 to 2	Bhadon.	Kartik.

Lands are generally manured at about 250 maunds per acre, or nearly nine tons. 12 tons is rather a low rate in England.

V. PRODUCE.

I now come to the last head—namely,

the productiveness of the land, and the costs and profits of cultivation.

The produce per acre in the various districts may be best gathered from a tabular statement from all districts,—such a one now follows :—It was compiled from returns supplied to the Lahore Museum in 1860. The rates vary much; but we must bear in mind that the estimate is only a proximate one; and that the differences of local situation, the facilities of irrigation, the absence of presence of "kalr" in the soil, the character and caste of the agriculturists, the

prosperity of the district generally, the moderation and justness of the Government assessment (amounting on an average to a third or a fourth of the estimated produce),* the definition and security of proprietary rights, have all of them great power to modify the agricultural prosperity of a district, and consequently to affect the area of land brought under cultivation, as well as the style of cultivation, and amount of produce.

* or to one-sixth in fairly lightly assessed tracts.

Division.	District.	Name of grain, &c.	Produce in grain per acre.	Produce in straw.	Average height of crops.	Division.	District.	Name of grain, &c.	Produce in grain per acres.	Produce in straw.	Average height of crops.	
LAHORE.	Lahore.	The particulars are given in a separate and detailed Table.					RAWALPINDI.	Gujrat.	Wheat, kanak Rohi,	22	8½	..
		Gujranwalla.	{	dágar, of 1st quality, ..	Maira,	15			8	..		
	Ditto, of 2nd quality, ..			Dosháhi,	16½	7½		..				
	Red wheat "lál kanak" (of 1st quality), ..			Rohi,	18	8½		..				
	Ditto (of 2nd quality), ..			Dosháhi,	16½	8		..				
	"Ghoni kanak" (of 1st quality), ..			Maira,	15	7½		..				
	Dosháhi,			12	6	..						
	Maira,			11	6	..						
	Amritsar.	{	Wheat, white (on rohi land), ..	16	12	3-6		Dosháhi,	11	6	..	
			Barley (on dosháhi land), ..	12	9½	2-0			Rohi,	12	6	..
Red wheat (on rohi land), ..			16	10	2-6	Dosháhi,	11		6	..		
AMRITSAR.	Sealkote.	{	Chola (gram) ditto, ..	14	2	1-3	Maira,	10	5½	..		
			Saron, ditto, ..	9½	..	3-0		Barley, "jan" (of 2nd quality), { Dosháhi,	14	3½	..	
	Gurdaspur.	{	Vadának wheat (1st quality), ..	15	12	4-6	Gram, ..	8½	..	..		
			Red wheat, "lál kanak," ..	12	10	4-0	Rice (cháwal), ..	14	..	..		
			Barley, ..	0	9	4-0	Maize (makkai), ..	10½	..	..		
			White wheat, from Adálatgarh, ..	10½	..	..	"Jawár" (<i>Holcus sorghum</i>), ..	7	..	..		
			Ditto, from Syjoké, ..	18	..	..	Bajra (<i>Penicillaria spicata</i>), ..	8½	..	..		
			Rice, from Chukrandás, ..	12	..	..	Dálmung (<i>Ph. mungo</i>), ..	7	..	..		
			Ditto, from Sfráhwalla, ..	8½	..	..	Ditto, massór (lentil), ..	7	..	..		
			Ditto, from Bakupúr of Pasroor, ..	8½	..	..	Dal másh, or úrad (<i>Ph. radiatus</i>), ..	7	..	..		
Gurdaspur.	{	Mustard seed, ..	2½	..	..	Mót kála (<i>Ph. aconitifolius</i>), ..	4	..	..			
		Sugar, ..	3½	..	..	Mót safaid (<i>Cyamopsis psoraloides</i>), ..	4	..	..			
		Rice, ..	10½	..	..	Chalodra or mandal (<i>Eleusine coracana</i>), ..	5½	..	..			
		Wheat, ..	7	..	..	Kaiyún (black pulse), ..	3½	..	..			
		Linseed, ..	2½	..	..	Cheena (<i>Panicum miliaceum</i>), ..	7	..	..			
		Taramfra, ..	3½	..	..	Dángri (pulse), (<i>Cajanus</i>), ..	5½	..	..			
Gurdaspur.	{						Karain (pulse), (<i>Cajanus</i>), ..	5½	..	..		
							Kodra, (<i>Paspalum scrobiculatum</i>), ..	5½	..	..		

Division.	District.	Name of grain, &c.	Produce in grain.	Produce in straw.	Average height of crops.	Division.	District.	Name of Grain, &c.	Produce in grain.	Produce in straw.	Average height of crops.
RAWALPINDIEE.	Shuhpur.	Millet (china),	mds. 12	mds. ..	ft. in. ..	DERAJAT.	Dera Ghazi Khan.	Gram,	mds. 8 $\frac{3}{4}$	mds. ..	ft. in. ..
		Ditto (kangni), (<i>P. italicum</i>),	11	..	..			Peas,	8 $\frac{3}{4}$	..	..
		Ditto (sawank) (<i>Oplismenum frumentaceum</i>),	5 or 6	..	..			Moth,	8 $\frac{3}{4}$	..	..
		Ditto (bajra),	8	..	..			Dal (mung),	5 $\frac{1}{4}$	..	..
		Ditto (jawar),	9	..	..			Mohri,	8 $\frac{3}{4}$	..	..
		Pulse (mash),	7	..	..			Simuka,	8 $\frac{3}{4}$	..	..
		Mung,	6	..	..			Sawank,	5 $\frac{1}{4}$	..	..
		Massur,	7	..	..			Gram,	5 $\frac{1}{4}$	..	..
		Moth,	8	..	..		Bunnoo.	Kangni,	6-10	7-16	3-4
		Lobiya,	2	..	..			Barley,	8-16	6-14	2-3
		Gram (chana),	10	..	..			China,	9	8	12
PESHAWUR.	Kuhat.*	Wheat (kanak), of 1st quality,	34	32	5	MULTAN.	Multan.	Wheat,	9	16	3
		Ditto (of 2nd quality),	34	32	5			Barley,	10	12	2
		Barley (jan),	48	60	3 $\frac{1}{2}$		Jhang.	Wheat (called rodi kanak),	12-19	10-17	2 $\frac{1}{2}$ -3
		Barley (jan),	40	5	2 $\frac{1}{2}$			Ditto (inferior land),	9-12	7 $\frac{1}{2}$ -10	2-2 $\frac{1}{2}$
	Peshawur.	Wheat (kanak),	5-8	..	..			Wheat (canal land),	13-20	15-21	3-3 $\frac{1}{2}$
		Barley (jan),	6-12	..	..			Ditto (inferior land),	10-13	8-15	2-2 $\frac{1}{2}$
		Rice (chawul),	8-12	..	..			Barley (canal land),	12-24	8-16	2 $\frac{1}{2}$ -3
		Oil seeds—sarshuf,	4	..	..			Ditto (inferior land),	6-10	4-6	2-2 $\frac{1}{2}$
	Hazara.†	Wheat (kanak),	10 $\frac{1}{2}$	..	..		JALANDHAR.	Wheat, { Chahi, .. 10	..	..	..
		Ditto (makkewalla),	5 $\frac{1}{2}$	..	..			Barley, { Barani, .. 4	..	..	..
		Ditto (pamban),	7	..	..			Barley, { Chahi, .. 11	..	..	..
		Barley (jan),	8 $\frac{3}{4}$	..	..			Barley, { Barani, .. 4	..	..	..
		Black barley,	8 $\frac{3}{4}$	..	..			Gram,	20	..	..
		Rice,	12 $\frac{1}{2}$	..	..			Bajra,	4	..	..
DERAJAT.	Dera Ghazi Khan.	Ditto,	12 $\frac{1}{2}$	..	..			Maize, { Chahi, .. 16	..	..	..
		Bajra,	10 $\frac{1}{2}$	..	..			Maize, { Inferior, .. 8	..	..	..
		Jawar,	10 $\frac{1}{2}$	..	..			Chari (jawar),	5	..	..
								Mash,	8	..	..
							Hushyarpur.	Wheat of 2nd quality,	8	15	..
								Barani, .. 6 $\frac{1}{2}$	..	..	..
CIS-SUTLEJ STATES.	Amballa.	Wheat (rausli),	18	54	3			Best rohi,	12	22	..
		Gram (khadir),	15	30	1 $\frac{1}{2}$			Ditto of 1st quality,	24	25	..
		Linseed (khadir),	3	..	1 $\frac{1}{2}$			Barani,	12	20	..
		Lentils,	5	5	1 $\frac{1}{2}$		Ludhiana.	Wheat,	16	..	..
	Ludhiana.	Wheat,	16	..	..			Rice,	14	..	..
		Rice,	14	..	..			Barley,	14	..	..
		Barley,	14	..	..			Maize,	19	..	..
		Maize,	19	..	..			Jawar,	19	..	..
		Jawar,	19	..	..			Bajra,	13	..	..
		Bajra,	13	..	..			Gram,	19	..	..
		Gram,	19	..	..			Moth,	66	..	..
		Moth,	66	..	..			Mash,	..	..	..
		Mung,	10	..	..			Mung,	10	..	..
		Sesamum (<i>til</i>),	6	..	..			Sarsón,	11	..	..
		Sarsón,	11	..	..						

* Kuhat—I believe this and the Peshawur rate to be a mistake, unless the maunds are "kucha," from 18 to 20 seers instead of 40.

† The list given by MAJOR ABBOT to the Agri-Horticultural Society of produce in Hazara (where the soil is classed according to the number of harvests it yields), is as follows :—

Name of grain.	Tin-fasli soil.	Do-fasli soil.	Ek-fasli soil.
		mds. srs.	mds. srs.
Maize,	12 maunds,	8 0	6 0
Cotton,	2 $\frac{1}{2}$ maunds,	3 0	2 0
Rice,	..	..	12 0
Wheat,	..	4 0	..
Kangni,	..	..	2 20
Bajra,	..	..	2 0
Mash,	..	..	1 8
Mung,	..	..	2 0
Moth,	..	..	2 0
Rawan,	Sown always with other grain,	..	2 0
Wheat,	4 maunds, 34 seers,	3 20	8 32
Barley,	9 maunds,	6 0	4 20

Division.	District.	Name of grain, &c.	Produce in grain per acre.	Produce in straw.	Average height of crops.	Division.	District.	Name of grain, &c.	Produce in grain per acre.	Produce in straw.	Average height of crops.			
DELHI.	Delhi.	Wheat, ..	6½-16	..	..	HISSAR.	Rohtak.*	Daúdi wheat, ..	6-14	..	..			
		Barley, ..	6-16	..	..			Rice, ..	7-12	..	..			
		Barley, on unirrigated land, ..	2-4	..	..			Barley, ..	8-14	..	..			
		Jowar, ..	5-10	..	..			Maize, ..	6-18	..	..			
		Rice, ..	9-15	..	..			Kangni, ..	6-12	..	..			
		Gram, ..	6-14	..	..			Gram, ..	6-24	..	..			
		Gawár (<i>Cyamopsis</i>), ..	15-20	..	..			Mung, ..	3-6	..	..			
	Karnál.	Karnál.	Wheat, { Irrigated best land, ..	13	15			3	* More recently I have received from the Deputy Commissioner of Rohtak, under his letter No. 592, dated 18th August, 1864, the following Table, showing the produce in canal and rain irrigated villages.					
			Bángar, ..	7	7			2½						
			Rausli, ..	9½	9½	2½								
Barley, { Irrigated best land, ..			12	12	2½									
Bángar, ..			7	7	1½									
Khádir, ..			9½	9½	2									
Gram, { Irrigated best land, ..			9½	6½	2									
Bángar, ..			10	8	1½									
Khádir, ..			9½	9½	1									
Sarson, ..			5	5	4									
HISSAR.	Hisar.	Rice, the kind called bás-máti, ..	12	..	..	Wheat,	10 maunds.	7 maunds.						
		Rice (shakar chiní), ..	10	..	..	Paddy,	12 "	...						
		Ditto (mánjí), ..	10	..	..	Barley,	12 "	5 "						
		Jawí or javi (oats), ..	15	..	..	Imphee,	6 "	7½ "						
		Jowar, ..	9	..	..	Indian corn,	7 "	8 "						
		Gram, ..	18	..	..	Bajra,	6 "	10 "						
		Móth, guwár, mung, ..	9	..	..	Kangni,	7 "	2½ "						

One or two districts, from the peculiarities of the situation, or means of irrigation, could not conveniently be included in the above Table; they are given separately.

Such are the Sirsa and Kangra districts; the former remarkable for the irrigation effected by the overflow of the river Ghagar; the latter by its mountain streams and peculiar rice crops.

PRODUCE OF SIRSA.—I. PRODUCE OF TRACT ON THE BANK OF THE SUTLEJ.

Local name of the grain or quality of the grain.	Whether grown with irrigation or not.	Average height of stem.	Soil in which grown.	Average yield per acre.		Remarks as to outward appearance.
				Grain.	Straw.	
Kanak "paman" (wheat, of large size, long grain, and translucent appearance), ...	By irrigation, ...	feet. 4½	Rausli and dakur,	10 0	15 0	Long and dark color beard.
Kanak "daūdkhānī" (wheat of very white color), ...	" ...	3	"	7 20	11 10	No beard at all; consumed chiefly by wealthy people.
Kanak, "lāl" (wheat of smaller size, and reddish appearance), ...	" ...	3	"	9 0	13 20	Short & white beard.
Jau (barley), ...	By irrigation and rain, ...	4	Rausli and bhoor,	12 0	12 0	Short beard and ear.

II. PRODUCE OF THE TRACT ON THE BANK OF THE STREAM GHAGAR.									
Kanak, "lál" (wheat of small size, and reddish color),	By irrigation, ...	3	Rausli and dakur,	12	0	24	0	Long & white beard.	
Jan (barley),	By irrigation and rain, ...	3	Rausli, dakur and bhoor, ...	12	0	12	0	Long beard and short ear.	
Chola (gram),	By ditto, ...	1½	Dakur and rausli,	15	0	30	0		
III. BY RAIN.									
Jan (barley),	By rain, ...	2½	Rausli,	4	26	9	12	Long beard and ear.	

KANGRA DISTRICT.

Crop.	Produce per acre.	Quantity of seed required for sowing.	Remarks.
Wheat, ...	7½ maunds,	26½ seers,	Principally in Kangra valley. Grows also higher up on the mountains. One return gives about 16 maunds an acre or ten maunds a beegah; perhaps this includes the cobs. MR. BARNES mentions that he has counted 1100 seeds on one head of rice. One return gives only 3½ maunds of husked rice, but that was a fine quality.
Barley, ...	6½ "	35 "	
Maize, ...	8½ "	8 "	
Rice, ...	14½ "	44 "	
Amaranth (<i>Chaulai</i>), ...	4 "	...	Usually sown mixed with <i>halih</i> . Both Kulá and Kangra.
Mandal (<i>Eleusine</i>), ...	6 "	...	
Másh, ...	2 "	5½ seers,	
Gram, ...	9½ "	2 "	
Chinán, ...	4 "	...	
Ginger, ...	4 "	...	

STATEMENT SHOWING THE QUANTITY OF THE SEVERAL SORTS OF GRAIN PRODUCED AT LAHORE.

Name of grain.	Time of sowing.	Number of times of ploughing.	Quantity of seed per acre.	Cost per acre.	Quantity of grain produced.	Remarks.
Wheat. ...	October. ...	7 or 8 times.	1 to 1½ mds.	It does not need hoeing.	25 to 30 mds.	Abundantly produced in mahjah and kalr lands (high lands from the river), but very little near the Rāvi banks; if sown there, the crop produces more grain.
Barley. ...	October. ...	4 to 5 times.	35 to 40 srs.	Ditto.	35 to 40 mds.	Kalr land produces more grain and less straw than the others. Barley is mostly used as a food for horses, and very little by the men of lower classes. It is made into sattu, or flour, made after parching the grain. The crop does not need hoeing. Barley parched is called <i>khat</i> , and with gram, <i>channa-chabina</i> .
Gram. ...	Sepr. & Octr.	2 or 3 times.	12 to 15 srs.	Ditto.	20 to 25 mds.	It is eatable when parched, and is used as dāl (split gram); when ground into "besan" it is used for making sweetmeats. In its raw state it is food for horses.
Mustard. ...	October. ...	4 to 5 times.	10 to 12 chs.	It needs hoeing.	3 to 4 mds.	From its seeds oil is extracted, which is used for many purposes: the stalk is useless.
Masūr or lentils. ...	Ditto.	2 or 3 times.	25 to 28 srs.	It does not need hoeing.	15 to 20 mds.	It is used as dāl, and is made into bread: the <i>bhāsa</i> answers well for the food of animals, and the grain is given to the bullocks.
Churāl. ...	Ditto.	2 or 3 times.	Ditto.	Ditto.	Ditto.	Cooked as dāl, its flour is baked into chapaties, and its stalk for cattle.
Linseed. ...	Sepr. & Octr.	5 or 6 times.	10 to 28 srs.	It needs hoeing twice.	Ditto.	If it is cultivated for its fibre, it is sown with 28 seers of seed to an acre, otherwise 10 seers is sufficient. If grown for oil its stalk is useless: the land is manured before sowing: the crop is watched.
Rice, of all descriptions. ...	May & June.	4 to 5 times.	12 to 15 srs.	Rs. 3-8.	35 to 40 mds.	Kalr land produces very good rice, but not so the mahjah land. It is a very wholesome food; from it are made sweetmeats, the flour is baked into chapaties. The straw is not so useful for fodder as the other straw, therefore its chief use is as a litter: the land in which it grows is manured: the crop is watched when standing green in the field.
Sesamum. ...	July. ...	3 or 4 times.	10 to 12 chs.	...	2½ to 3 mds.	It yields an oil and is used in making sweetmeats. Hindūs on one of their fasts use it for food.
Jawār (<i>Holcus sorghum</i> .) ...	Ditto.	Ditto.	20 to 25 srs.	No need of hoeing.	...	When green answers well as fodder for cattle, and called "charri." The parched grain is eaten by the country people. Its flour is baked into chapaties.

Name of grain.	Time of sowing.	Number of times of ploughing.	Quantity of seed per acre.	Cost per acre.	Quantity of grain produced.	Remarks.
Mash. ...	July & Augt.	2 or 3 times.	5 to 8 seers.	No need of hoeing.	5 to 7 mds.	It is used as dāl, and mixed with rice, makes "kichri." In famine its flour is made into chapaties by the country people; also "baris" are made of it by soaking the grain in water for a night; next morning the soft grain is gently rubbed to remove the skin, it is next ground on a flat stone and mixed with spices, this paste is made into balls, which are put for a time in the sun till they dry.
Méth. ...	June & July.	2 or 3 times.	5 to 7 seers.	Ditto.	4 to 5 mds.	Dāl and kichri is made of this, and very seldom chapaties of its flour.
Mūngi. ...	July. ...	2 or 3 times.	3 to 4 seers.	Ditto.	7 to 8 mds.	Ditto, ditto, ditto.
Bajra. ...	June or July.	3 or 4 times.	3 to 4 seers.	Ditto.	8 to 9 mds.	The people when in need make bread of it and also kichri: it is food for birds; it is much eaten however in the tract or country called Phattowar, between the Jhilam and Indus.
Kangni. ...	Ditto.	2 seers.	1½ to 2 seers.	Ditto.	10 to 12 mds.	Ditto, ditto, ditto.
China. ...	Ditto.	2 seers.	2 to 2½ seers.	Ditto.	8 to 10 mds.	Ditto, ditto, ditto.
Sawānk. ...	Ditto.	4 seers.	2 to 2½ seers.	Ditto.	8 to 10 mds.	It is made into "khir" (grain and milk boiled together). Khushkah, gram boiled in water, kichri, &c.
Maize. ...	Ditto.	6 or 7 times.	28 to 30 seers.	Ditto.	40 maunds.	It is made into bread; the boiled grain is used for eating. It is generally parched and sold in bazar by people for eating, called "challi" and "sitta;" also it is used as dalya.
Mandal. ...	July. ...	2 or 3 times.	10 to 12 seers.	Ditto.	10 to 12 mds.	Useful for making bread, and is a sort of food for animals.
Kodra. ...	Do. ...	2 or 3 times.	10 to 12 seers.	Ditto.	10 to 12 mds.	Bread is made of it; also kichri,—grain and rice boiled in water.
Arve or gūyāñ.	Feb. & Mar.	8 or 10 times.	6 to 7 seers.	Rs. 18.	100 105 mds.	The root is used by Natives and Europeans as an article of food. It is procurable in every season of the year.
Potato. ...	October. ...	Fifteen times.	6 to 7 seers.	Rs. 25.	140 maunds.	Ditto, ditto, ditto.
Sugar-cane, ...	Feb. & Mar.	15 or 16 times.	Rs. 19.	Rs. 20.	150 maunds.	It is much esteemed by all classes, who chew it as a sweatmeat; the process of sugar-making is described later in the book.
Musk-melon, water-melon, &c.	Ditto.	12 or 14 times.	Rs. 3 to 4.	Rs. 15 or 16.	Rs. 37 or 68.	Esteemed as a fruit.
Cotton. ...	April & May.	5 or 6 times.	9 to 10 seers.	Rs. 12.	5 to 6 mds.	A fibre.
Red pepper. ...	Ditto.	5 or 6 times.	Rs. 2½.	Rs. 12.	Rs. 20.	When dry, the produce is about five maunds per acre.

It is now time to close this somewhat protracted agricultural sketch, with some tables illustrating the costs of cultivation and the profits of agriculture. I need hardly remind the reader that the Government assessment on lands is intended to be at the rate of about a fourth, and should not be more than one-sixth of the *gross* produce, ascertained at the time of settlement by careful enquiry, both as to existing assets and future capabilities. There can be little doubt that the majority of settlements are now on equitable terms, although it must be admitted that there is much inequality on the pressure of the assessments. The revision of settlement, at present in progress in many districts, cannot fail to remedy this defect to a great extent; and the security of a just and moderate assessment for a long period cannot fail to encourage agriculturists.* It has been said that, in some of the fertile districts of the Punjab, a portion of the kharif harvest alone is sufficient to pay the Government share, leaving almost the entire rabi, as clear profit to the farmer, that is as his own assets from which he pays his costs and expenses, and draws his profit. There can be little doubt that this is the case, and in a state of profound peace, when the agriculturist knows that the sum once assessed cannot be augmented during the continuance of the term specified in his settlement contract, he has every inducement to enlarge his efforts, and thus surely increase his profits. It only remains for us to overcome the great drawbacks to improvement that exist in the slothfulness of the people, and where they are not slothful (as many agricultural tribes

are not), to overcome that aversion to change which leads them to be perfectly satisfied to plod on at the same rate now as they did 2000 years ago. Suggestions on these points will be found on the report of the jury on this class. I will only add here that one of the most powerful checks on cultivation that is in existence consists in the taxation of capital in assessing lands. It requires the nicest discrimination on the part of the assessing officer, and ought to receive his earnest attention, to see that capital is not taxed, otherwise the people will cease bringing land under cultivation, and cease sinking wells from the mere dread of an enhanced rental, which if carelessly assessed according to mere *apparent assets*, will surely result in the crushing of agricultural enterprise.

I now give some lists showing the costs of cultivation in different parts. The first is a transcript of MAJOR CLARKE's estimate, which gives the costs and profits on 34 acres of land attached to a first rate well, in the pergunah of Shekopúra in the Rechna Doab, which will give a fair representation of the majority of good lands in the Punjab, (excluding of course bar lands, and sandy, "tibba," tracts,) where the produce is assumed to be first rate in quantity.

The 34 acres sown for the year are supposed to be sown thus, 12 acres for kharif, 22 for rabi:—

22 ACRES FOR RABI.	12 ACRES FOR Kharif.	2 ghumaos of land for sugar-cane, or nearly 2 acres.
		2 acres of cotton.
22 ACRES FOR RABI.	12 ACRES FOR Kharif.	1 acre of rice.
		1 acre of sarson (rape or mustard seed).
		4 acres of jawar (<i>Holcus sorghum</i>).
		2 acres of maize.
22 ACRES FOR RABI.	12 ACRES FOR Kharif.	18 acres of wheat.
		2 acres of barley.
		2 acres of gaj (wheat and barley mixed).

Then the cost and profit will be as follows:—

* The question of a permanent settlement is also under discussion; the subject is one of the greatest importance, but cannot be entered on here, because if any remarks were offered either on one side or the other, it would be impossible to avoid going into the whole subject.

Quantity of land under crop.	Crop.	Produce in kind.	Produce in money.		Expenses, including revenue, and all cesses at 1/4th of produce.		Expenses of ditto at 1/4th of produce.		Profit to cultivator or former paying 1/4th of produce.		Ditto paying of 1/4th of produce.	
			RS.	A. P.	RS.	A. P.	RS.	A. P.	RS.	A. P.	RS.	A. P.
2 acres, ...	Sugar-cane, ...	80 mds. (goor,)	200	...	149	9	163	3	50	7	36	12
2 „ ...	Cotton, ...	24 „	48	...	34	9	39	2	13	6	8	13
2 „ ...	Maize, ...	40 „	26	10	17	11	20	6	8	14	6	3
1 „ ...	Rice, ...	24 „	24	...	13	9	15	14	10	6	8	1
1 „ ...	Mustard, ...	8 „	8	...	4	8	5	3	3	8	2	12
4 „ ...	Jawár, ...	32 „	21	5	22	3	Is used as fodder and the cost becomes almost nothing.					
12 „ ...	...	..	327	15	242	3	243	14	86	10	62	10

RABI.

18 acres,	...	Wheat,	...	304 mds.	...	304	...	...	198	...	9	226	14	6	105	15	3	77	1	6	
2	„	...	Barley,	...	32 „	...	21	5	3	11	14	6	14	1	3	9	6	9	7	4...	
2	„	...	Gúji,	...	32 „	...	25	10	...	14	8	...	16	14	6	11	2	...	8	11	6
22 Total, ..				...	...	350	15	3	224	7	3	257	14	3	126	8	...	93	1	...	
Grand Total,				...	...	678	14	3	466	10	3	501	13	...	213	2	...	155	11	9	

I have added one more Table of the costs and profits of land, extracted from that very able and interesting volume, the Report on the Revised Settlement of the Sealkot District in 1865, by MR. E. A. PRINSEP. These tables are interesting from their great accuracy, as well as from their showing the state of things in a richly cultivated district like Sealkot. From the Appendix to these tables a very good idea will be obtained of the proportion in which the Government revenue tax falls on the produce, and how equitable rates can be ascertained: the tables as here given are somewhat reduced in form from the originals, which, together with the illustrative matter of para. 241, *et seq.*, should be studied in the original report; the whole work will repay perusal.

The land taken as a standard is 30 gh-

maos, attached to one first class well in the Charkari Mahál, or well abounding tract of the district.

The total expenditure for a year from pukka well, irrigating 30 ghumaos, in the Charkari Mahál of Sealkot is:—

		R.	A.	P.
Wages of labor.	Ploughman, @ 2 maunds kucha per mensem and 1 rupee cash, ..	22	0	0
	Coolie, per annum, ..	4	0	0
	Cowherd, ..	26	0	0
		52	0	0
Farm service.	Potter, @ 1 máni per harvest, ..	10	0	0
	Carpenter, @ 1/2 máni, ..	5	0	0
	Carpenter, @ 1/2 máni, ..	5	0	0
		20	0	0
Cost of fodder and keep of stock.	5 Yoke of oxen's feed, besides grass and clover, @ 1/2 a máni per head per annum, or cash charge for salt, Rs. 2, ..	27	0	0

		R.	A.	P.
Repair of ploughs & tools.	5 Ploughs, @ Rs. 0-8 per plough, per annum, ..	2	8	0
	Iron for trowels (<i>rambha</i>) scythes (<i>dātri</i>), &c., ..	1	0	0
	Ditto, for spades, ..	1	0	0
	Well rope, required every 2 months, @ Rs. 1 per "māl," ..	3	0	0
		7	8	0
Value or cost of seed.	1 Ghumao sugar-cane; @ 1 pai per 4 marlahs,	6	0	0
	2 Do. cotton, @ 16 do., ..	0	4	0
	4 Do. maize, @ 1 topa per kanal,	2	0	0
	4 Do., "charri," @ 3 do. do., ..	2	8	0
	Total (<i>Autumn crop</i>), 12 { ghumaos, ..	8	12	0
	10 Ghumaos wheat, @ 1 pai per kanal, ..	8	0	0
	4 Do. "guji," do., do., ..	4	0	0

		R.	A.	P.
Value or cost of seed.	2 Do. barley, @ 3 pai do., ..	2	0	0
	3 Do. turnips, @ 1 pai per ghumao,	1	0	0
	½ Do. flax, @ 1 pai per kanal, ..	0	3	0
	½ Poppy, @ Rs. 2 per ghumao, ..	0	1	0
Total (<i>Spring crop</i>), 18 ghumaos, ..		15	6	0
Grand total, Rs., ..		130	8	0

NOTE.—One māni is equal to 12½ maunds kucha. A maund kucha is variable, from 12 to 20 seers, being usually counted 2½ kucha = 1 pukka; the standard maund is 40 seers of 80 tolahs each.

The standard maund is sometimes called, *pakka* or *Angrezī*, but more often the term *pakka* is applied to the "Lahori maund," the old weight which is rather heavier, viz., 3 kucha maunds = 1 Lahori.

Annual gross income for one pukka well, irrigating 30 ghumaos of land, in the Charkari Mahāl, Sealkot district.

Harvest.	Area under crop, in ghumaos.	Usual distribution of crops.	Average yield per ghumao, in kucha maunds.	Average market price for 30 years (per rupee).	Yield in the de- duced money equi- valent.	Total value in money for whole crop.	Grand total value.	
Autumn (kharif), 12 ghumaos, at an average gross rate of Rs. 12-10,	2	Sugar-cane,	45	1½ maunds,	32	64	152	
	2	Cotton, . .	20	1¼ "	16	32		
	4	Maize, . .	24	2 "	12	48		
	4	"Charri," . .	...	per ghumao,	2	8		
Spring (rabī), 18 ghu- maos, at an average gross rate of Rs. 17-9,	10	Wheat, . .	30	2½ maunds,	13-4	140	208	
	4	Guji, . .	35	3½ "	10	40		
	2	Barley, . .	40	4 "	10	20		
	1	Turnips (not counted, as consumed by cattle).						
	½	Flax, . .	10	2 "	5	5		
	½	Poppy, . .	...	per ghumao,	6	3		
	Grand total of the 30 ghumaos, for both harvests,							360

Space forbids me to extract from the Sealkot report the remaining Table, which fills up the page in the original, and which shows how an equitable revenue rate per well can be deduced from the above data. To summarize the results in the form of a percentage, it will be found that calculating the gross proceeds of 30 acres, at a money value of Rs. 360, this gives Rs. 12 an acre; and the following scheme will show the costs and

profits according as the Government revenue is assessed at Rs. 2-8 or at 2 per acre.

At Rs. 2-8.				At Rs. 2-0.			
		RS.	A. P.		RS.	A. P.	
Expenses, ...	...	130	8 0	130	8 0		
Subsistence, ...	...	100	0 0	100	0 0		
Interest, &c., ...	...	17	10 0	15	8 0		
Revenue and cesses, ...	...	85	8 0	68	6 0		
Profits, ...	...	26	6 0	45	10 0		
Profit at 7 per cent.				Profit at 13 per cent.			

Where the Government revenue demand is at the rate of Rs. 2-8 per ghumao, the farm expenses and subsistence of two families are 64 per cent., interest on revenue and cash payments of farm, 5 per cent.; Government revenue, 23-5 per cent.; leaving nett profit, 7-4 per cent.: or if the Government rate be Rs. 2 per ghumao, then these figures will become 64 per cent., 4-2 per cent., 18-6 per cent.; and profits, 13-0, respectively.

Under the various headings of the collection will be found an occasional list of costs in detail of the cultivation of the various crops.

When the owner does not cultivate, but receives his malikana, the profit to him is nearly the same.

The last point I shall notice, is the native classification of diseases and blights incident to crops, and again quote MAJOR CLARKE,* and MR. E. A. PRINSEP.

Corn is lodged (hawá-zad) by strong wind, and is injured by want of rain, frost, hail, rats, jackals. The following are the names of insects, animals, and diseases which injure crops.

Sugar-cane.—Tela, huda, keeree, soka, pála, nisurna, moosh, kuchra, and kungeearee.

Cotton.—Phirtee, tela, soka, pála (frost) and rats.

Makai.—Keeree, toka, siyank, tupke.

Churee.—Keeree, toka and tela.

Rice.—Jholur and rats.

Moth, mung and mash.—Tela, toka, and bhutoth, or poachur.

Wheat, barley and goojee.—Koongee, lakha, jholur, pataka, toka and kungeearee, and trel.

A few of the above may be specifically mentioned.

Koongee.—A red rust. The “koongee,” as far as I can discover, is a blight that comes upon young wheat (which is sown late) in the months of January and February, after much rain. If there has been several days of rain, and followed by a cessation for three or four days, and during this time the sun does not appear, but heavy lowering clouds, hanging about bringing sultry weather, then this red “rust” appears on the ears of wheat. The damp is said to bring it on, but it goes away if the sun shines after rain, or the cold wind ceases. It attacks wheat and nothing else, barley is quite free from it, because it is believed that barley is not a grain that is heating. Gram and mussoor, which are sown at this time as wheat are free from it; this “koongee” is the chief disease wheat is liable to. It appears always first at the junction of the large leaf, with the blade; and thus spreads to the young ear, if it should disappear in three days, then there is hope for the crop. If it lasts and spreads beyond that time, then the crop is ruined, generally it reduces the yield by about one-third; sometimes by half; the disease lasts altogether about ten days, and when in its height so extensive is the “red rust” that is accumulated, that if a man walks through the field, his feet and legs will be quite covered over with a coating of red.

If the clouds break, after rain has ceased, and the sun comes out, then the blight is driven away. If a breeze blows from east at the time, it is intensified, but if the wind shifts round to west, it is blown off on the ground. The chief cause is assigned to the pressure of lowering clouds. If they are disturbed by the sun breaking out, or by a breeze removing the sultriness in the air; then there is hope of the blight disappearing in such cases, all that will remain will be mere discoloration. If, however, the sultry state of the atmosphere continue for three or four days continuously, then the disease is looked upon as certain to affect the whole crop. If timely rain, or west-wind intervenes, *within the three first days* of its first appearance, then it is washed or blown off, and no real harm is done, for the disease has had time only to get on the leaf, and not to spread to the ear of wheat in the leaf. The wheat leaf will gather its strength and greenness as it grows, and all trace of the discoloration even, will in such cases disappear.

The actual loss sustained by the crop is not known till the wheat ripens. The ear is found to have no grains, and where most of the blades turn out grainless, they turn yellow, and show what loss has been done about one month and a half after, *i. e.*, in the first fifteen days of April.

* Agriculture of the Récana Doab.



Tela.—Is a dark colored powder, saltish to the taste, which lies between the outer and inner coating of sugar-cane and stops its growth, the only remedy for it is to wash it off with water. In wheat it causes the plant to turn black. (The “smut” on wheat, &c., is called *kali atta*; it is a fungoid growth).

Huda.—The drying up of leaves, and their becoming yellow in Sāwun and Bhadoñ, without any apparent cause.

Nisarna.—This is not a disease, but it is esteemed very bad for sugar-cane to blossom (nisarna), and such canes as blossom, being evil-omened, are taken up, and given to whomsoever will have them.

Pāla.—Frost, when the north wind blows piercingly, it and the cold discolor the cane, the taste of which becomes saltish, and the produce is inferior; the cane has also a disagreeable smell, and the top dries up.

Kuchra.—In Jeth and Har, when the young cane is about 20 inches high, this insect eats the heart, and does very great injury to the crop, destroying as much as half perhaps.

Kungearee.—These are barren branches, growing out of the cane, which do not give juice, neither will cattle eat them; if kungearee prevail much in a crop, it injures it to the extent of one-twentieth.

Keeree.—An insect so called which eats the germ of young plants, particularly of sugar-cane. In Jeth and Baisākh, sometimes the crop is destroyed by it; rain or water is the best remedy; sometimes the “madār” plant (*Calotropis Hamiltonii*) is cut, and laid in the water which is to irrigate the field; the bitterness thus given destroys the keeree.

Soka.—Is occasioned by want of water, the cane dries inside, becomes hollow, and throws out great quantities of “choee,” or outer leaf.

Phirtee.—In Jeth and Har, young cotton plants, in maira soil, are liable to be injured by sand storms, which wound them, and they dry up. The remedy for this is to water the crop, by which means the sand holds together. Phirtee also injures sugar-cane.

Toka.—Is a moth, which injures young shoots by nipping them off, as if with a pair of scissors.

Dhimak, or *white ants*.—If rains do not fall in Sawun and Bhadoñ, white ants do great damage: rain kills them.

Trel or *dev*.—If heavy dews fall in Assuh and Kartak, the jowar crop is much injured, the grain cracks and becomes dark and almost friable.

Bhutokh.—This disease arises from the east wind blowing, which causes moth, mash and mung to shrivel up, and the pods do not fill.

Lishk, or *Lightning*.—Should it lighten much when gram is about to form its flowers, it injures them, and

the pods do not fill well, and an insect is also produced thereby.

Tuphee.—When the rains are very heavy, the stalks of Indian-corn shoot up, and spindle, and yield no grain.

Another drawback to good crops, particularly in districts below the hills, such as Gujrāt, Sealkot, and Gurdāspūr, is the frequency of hail-storms, which are prevalent in the months Phaggan and Chet, sometimes they come in October. At the former season they always cause much injury to wheat when it begins to ripen. In Tila in the Jhīlam district, the “jogis” are propitiated to presents, to come and forwarn the people of storms. They plunge into a field with a drawn sword, or a knife is stuck into a mound with offerings placed round it; goats are often sacrificed, and people are stupid enough to pay for this deception. Lightning does damage to such crops as gram, masūr, flax, and tīl, which are called “phoilsah,” or lishk-mār, lightning-struck, in consequence. The flowers fall off and the seed is lost.

Crops are preserved from birds by scare-crows, or “darānas.” A blackened earthen pot stuck on a stick being a favorite method. In the case of tall crops, such as sugar-cane, &c., light platforms, called “manas” are erected, on which a person is stationed day and night to frighten birds, by shouting and discharging clay pellets, &c., &c.

Notwithstanding that the Punjab is a great grain producing country, some grain is imported from Malwa and the fertile districts, in its neighbourhood, the mart for whose produce is the city of Jhānsi, whence the grain is exported northwards. The internal traffic in grain is considerable, from the fertile districts. Large quantities of grain comes down the Sutlej to Firozpūr. Rice is largely exported from Kangra to other districts. Hushyarpūr and the Jālandhar district supply much grain also to other districts. Sugar is exported largely from parts of the Punjab, both in a finished state and as “goor,” or molasses. Latterly there has arisen a large export trade of wheat and sugar, cotton and oil seeds, towards England, *viā* Mūltān and Bombay.

I. CEREALS.

WHEAT.

Botanical name—*Triticum vulgare*, Wild.

Native names—Kanak, Gehún, Gandam, (Persian).

Wheat of all kinds is principally the growth of the rabí (spring) harvest. The number of varieties is not in reality very great, though considerable difference of nomenclature exists.

Some of the specimens exhibited are very fine—large white clear grains—but on the whole it must be admitted that much remains to be done for the agriculturist by an improved selection of seeds. Some of the varieties are of recent introduction, such as the Gilgit wheat, from the territory of that name, north-east of Peshawur. The two principal kinds of wheat are the “lál,” or reddish-brown wheat, and “safed,” or white wheat. The latter is the most esteemed, and has several varieties—the former is cheaper, and certainly of not so pleasing appearance, but as the jury on this class remarked, does not appear to be in any way inferior in nutritious properties to the white sorts; on this account the use of this wheat is ordered in all jails in the Punjab.

Wheat is sown in the months of Kartak, and first half of Maghar for the rabí harvest, and is cut in Baisákh (April). When cut it is winnowed by men of the “chúra” caste, who receive as wages about 11 seers per mání (6½ maunds), and get certain gleanings that fall beyond the heaps. The straw when broken up is called “bhúsa” or “túrí,” in Punjabi, and is used for feeding cattle, and for various other purposes. The agricultural population do not generally eat the corn they grow, but reserve it for sale; they use barley, pulses, and other less valuable crops. Wheat is often sown mixed with barley; this is called “goji” in the Punjab, and “trikala,” in Cis-Sutlej States, or with gram (*Cicer arietinum*) and then called “bhera;” or the red and white varieties, are sown together under the name of “jogyáñ.”

The principal kinds of wheat are exhibited as follows:—

I. RED WHEAT.

762.—[]. “Lál kanak,” red wheat.
 DELHI MUNICIPAL COMMITTEE.

Red wheat is exhibited also from Ambálah (2652), Amritsar (2934), Lahore (3085). Value, 30 seers per rupee.

II. WHITE WHEAT:

Some of the samples are very fine. But there is every shade of difference conceivable; there is magnificent wheat from Yásin beyond Kashmir; very good wheat from parts of the Rawalpindi district, and also from Dera Ghází Khán. The principal varieties are the—

1. “Vadának,” or “pamman,” which is very like the dágur wheat of some districts.

2. The “ghoni” wheat, which has grains without skin or husk.

3. The Gilgit wheat (introduced), also called paighambri and Múltáni, small and very round grains.

4. The “daúd khání.” There is also a variety called “kathya” in Sirsa.

The principal difference observable in wheats, is that some are bearded and some are awnless. Of the bearded wheat there are two sorts, one with a dark colored beard, the other with a light yellow beard. The principal varieties of grain are in appearance distinguished by their (1), opaque whitish color, and the absence of skin or husk, like the “ghoni” and “safed kanak” generally; (2), by their being almost round, like pearl barley, such is the Paighambri wheat; * (3), by their being besides large in size, of great translucency and clearness; daúd khání, &c. The wheats of the Hill states are generally small and inferior in color. The territories exhibiting them are, however, very nearly on the limits where wheat ceases to grow, so the inferiority is not to be wondered at. 13,000 appears to be the ordinary limit of wheat,

* The varieties shown as Gilgit and Múltáni are apparently the same.



though it has been observed up to 15,000 feet in the Himálaya.

763. [2534], Ordinary white wheat, "safed kanak." Delhi.

The following districts also sent samples:—

Gurgaon (2571).

Karnál (2586).

Rohtak (2605).

Ambáláh (2651).

Ludhiana (2685).

Jálandhar (2822).

Hushyarpúr (three varieties, 2893-5), (one being a mixture of red and white wheat sown together, which is called jogyáñ).

Amritsar (2930).

Gújranwalla (ordinary white), (3164).

Jhílam (2nd class), (3235).

Gúrdáspur (3059).

Gugaira, four varieties (3723-6).

Muzaffargurh (3333): value 26 seers per rupee.

Dera Ismaíl Khán, two varieties, (3356-7).

Dera Gházi Khán (3382).

Bunnoo, (3423).

Peshawur (3440).

Hazara (3458).

Kapúρθála (3465).

Farídkot.

Jhínd (3761).

Nábha (3773).

The above are sent as "white wheat," without specification as to the variety to which locality they were assigned. The following varieties of fine wheat were exhibited as specialties—viz,

764.—[2640-44]. Series of wheats, grown at Fazilka and Sirsa. MR. OLIVER, Deputy Commissioner of Sirsa.

(a). "Pamman" wheat (otherwise called vadának): selling price, 30 seers per rupee.

(b). "Ghoni" wheat (small opaque white grain): the same price.

(c). "Dáúd Kháni," large and very white grain. Introduced from the N. W. Provinces, and grown chiefly on the banks of the Sutlej, on alluvial and irrigated lands. This is much used by sweetmeat makers on account of its being so white. It sells where grown, at about 31 to 32 seers per rupee, always cheaper than pamman, being considered inferior.*

(d). "Kathya wheat:" value, 30 to 31 seers per rupee.

(e). "Janglí wheat," an inferior grain, almost like a wilding, hence its name: value, 32 seers per rupee.

765.—[]. Series of wheats from the Simla Hill states.

The Simla district exhibits a number of specimens, most of them poor wheats; No. 2697 from Bhaji; Kothar (2756); Mahlog (2758); Dhámi (two varieties), (2773-74) Kanyár (2779); Balsain (2794); Baghat (2809); and Tiroch (2810).

766.—[]. Series of wheats from the Hill districts around Kangra. LOCAL COMMITTEE.

The fields among the hills below Kangra produce about 3 maunds per begah, or nearly $5\frac{1}{4}$ maunds per acre.

"Wheat and barley are universal everywhere as the spring crop. Of wheat there are several kinds, the bearded and the beardless, the full white, and the flinty, red variety. Barley is uniform. Wheat grows most luxuriantly in the talooquas of Mori, Rajgíri and Nadaun, the soil of the tertiary hills seems the most congenial to it. The produce on the granitic soil of the upper valley, is always poor and thin. Barley flourishes in Haripúr, and all along the base of the snowy range. The ripening of harvest takes place later than in the plains, and varies according to the varying elevation. The crops in the outer ranges will be yellow, and ready for the sickle, while the fields about Kangra are quite green, and the lower portion of the valley will be cut and carried a month before the grain is matured in the Palam valley. From the beginning of April till the end of May is a succession of harvest times, and in the remote talooqua of Bhúngawal, the barley (for wheat is there unknown), does not ripen till July.†

767.—[2873]. Wheat from Lahaul. "Gro" (pronounced dro, Thibetan). REV. H. A. JÄESCHKE.

This wheat is very remarkable from its being produced in such a locality. It is said to be far superior to the wheat of Kúlú, it is not greatly cultivated however, as it requires warm and protected localities and much irrigation. (For an account of Lahaul crops, see under "Barley.") Samples from Lahaul were also sent by the Kangra Committee.

768.—[2877]. Wheat from Spiti.

DR. ROYLE mentions that he has not seen wheat higher than 8,000 feet, but GERARD speaks of wheat at 10,000, and CAPTAIN WEBB of wheat at 12,000,

* Local Committee, Sirsa.

† BARNES' Settlement Report.

on the Southern slope of the Himálaya. The extreme limit is given at 13,000 to 15,000 feet.*

769.—[2884]. Varieties of wheat called “káh” or “kán,” and “tár,” from Spiti.

The culturable territory of Spiti is divided into five kotees (divisions). The whole of them together produce 20,667 lakhs of grain (1 lakh = 12 pukka seers) or about 6,200 maunds.

The value is from 2½ to 3 lakhs of barley, and 2 lakhs of wheat per rupee. The people exchange grain as much as they can spare with Bishahr for iron, Thibet salt, and tobacco.

770.—[2912, 2950, 3304]. Series of wheats from Amritsar. LOCAL COMMITTEE.

(a). “Dáúd khání.”

(b). “Máltání,” also called “Gilgit” and “rai munir,” small round grains.

(c). “Bhera,” wheat and gram mixed.

771.—[]. Large grained “vadának;” wheat grown in villages Adálatgarh, Syjoke and Sealkot. LOCAL COMMITTEE.

Value, 35 seers per rupee.

772.—[]. Series of the wheats of the Lahore bazar. FAKIR SHAMS-UDDIN.

(a). (3083) Vadának wheat: value, 28 seers per rupee.

(b). (3083) “Dáúd khani,” yields very white flour: value, 27 seers per rupee.

(c). (3086) “Kabir” wheat, not very common, and not of superior quality.

(d). (3087) Ghoni wheat: 27 seers 8 chittaks per rupee; sold as “paighambri” or “nikka” wheat.

773.—[3089]. Gilgit, called also paighambri wheat, grown at village Sándá, near Lahore. CHAUDRI IMAM BAKSH.

774.—Gujranwalla wheats.

(a). (3164) Vadának wheat (large grain).

(b). (3167) Fine wheat, perhaps dáúd khání.

(c). (3168) Gilgit wheat, small, clear round grains.

775.—[3192]. Fine vadának wheat from Pindi Gheb. RAWALPINDI LOCAL COMMITTEE.

COLONEL TREMENHEERE noted in his report on Agriculture to the Agri-Horticultural Society several

years ago, that the finest wheat he had seen was grown in the valley of Barhán, near the village of Hassan Abdál in this district, the soil being calcareous and yielding per acre about 14 maunds.

There is a good sample of wheat like this from Gujrát (No. 3206), and Jhilam (3234), and Shahpúr (called locally Dágar), from Naushera (3250), and from Dera Gházi Khán (3383). Gugaira, among its four varieties (3273-76) exhibits “Gilgit wheat.”

776.—[3524-28]. Four varieties of wheat, the produce of Srinagar, Kashmír. H. H. THE MAHARAJAH.

The 1st kind sells for 36 seers per rupee, and is the produce of the spring harvest.

The 2nd grown in the autumn harvest, and sells at 20 seers. The other two are valued at 29 seers.

777.—[3528]. Wheat from Yásín. H. H. THE MAHARAJAH OF KASHMIR.

This is a peculiarly fine and large grained wheat.

778.—[3529]. Gújí (wheat and barley mixed).

Wheat is very little cultivated in Kashmír, the staple crop is rice, what little wheat there is, is almost entirely produced at the spring harvest; but one sample (3524) is marked as being autumn produce.

BARLEY.

Botanical names—*Hordeum hexastichon*, *Hordeum celeste* (the beardless variety). Native names—Jau, (DR. CLEGHORN gives Ujou (Ajau) for *H. celeste* in the upper Sutlej valley).

Barley is cultivated much in the same way as wheat, but is ready for cutting somewhat sooner, it grows much on sailabá and bárání lands; it is much less esteemed than wheat, and sells much cheaper, though it produces much more, and requires worse lands and less watering than wheat. The varieties are “jau desi,” (common country barley), and “jau paighambri.” “Ghoni” jau is barley that has scarcely any husk at all but only a fine skin. In the Hills barley succeeds better than wheat, and is much cultivated: its upper limit is 15,000 feet.

There is a black or rather dark purple barley, and a clear translucent barley of

* Notes on the Vegetation of the Sutlej Valley, by DR. CLEGHORN, p. 14; Journal of the Agri-Hort. Society of India, Vol. xiii, p. 4.

superior quality, both called *paighambri*, I believe that the term *paighambri* is applied as an equivalent for "superfine" or "uncommon." I have heard the "Gilgit wheat" called "*paighambri*:" "*paighambri* jau" literally means the "Prophet's barley."

779.—[]. The exhibited samples of common barley, or "*jau desi*," were as follows:—

Delhi (2536).

Gurgaon (2572).

Kurnál (2587).

Rohtak (8607).

Sirsa (8633): value, 1 maund 10 seers per rupee.

Ambálah (2653).

Ludhiana (2687).

Jalandhar (2823). In the Jalandhar district, barley is usually sown with wheat; if sown on unirrigated land the yield is 5 maunds an acre, if irrigated about 11 maunds. It is cultivated at a cost of Rs. 2½ per acre.

Hushyarpúr (2900).

Rawalpindi (Pindi Gheb, 3191).

Gujrát (3207).

Jhílam (3236).

Shahpúr (3251).

Muzaffargarh (3334): value, 1 maund 5 seers per rupee.

Jhang (Maghyána pergunah), (3351). This latter was the only exhibited sample of any crop produced at Jhang, though there are samples of wheat from Jhang, in the Lahore Museum.

Dera Ismaíl Khán (3363).

Dera Ghází Khán (3385).

Bunnoo (3430).

Peshawur (3431): value, 1 maund 12 seers per rupee.

Kapúthalla (3466).

Nábha (6774).

The finer kinds of barley, including the produce of the Hill districts, exhibited as specialties, were as follows:—

780.—[2633]. Black (purple) barley, recently introduced from the provinces. Mr. OLIVER, Deputy Commissioner of Sirsa.

West of the Sutlej it is grown on lands inundated by the Ghágar river, but few acres have as yet been sown, but the Zamindars intend extending it.

781.—[]. Barley from the Simla

States. The series consists of samples from Bhaji (2697); Kothar (2747); Mahlog (2759); Balsan (2795); Tiroch (2811); Bishahr (fine quality) 2815; the Deputy Post Master of Kotgarh exhibited "imperial barley" (2817).

782.—[2837]. Barley, the produce of Kangra and Kúlú.

783.—[]. Barleys from Lahaul. the REV. MR. JÆSCHKE.

784.—[]. Barley of the sort called "*sermo*."

Short but rich ears with short awns and six rows of grain, cultivated in Ládah and Lahaul, not in Kúlú.

(2871) Large barley. "*Che-nas*" (*nas*, pronounced *né*).

(2872), Early barley. "*Gyog-nas*," (Tibetan) and "*Yangma*," in Ládakh, and "*Thangzad*" in Bunan dialect.*

It is also called "*drug chnnas*," barley of sixty days, because it is said to ripen in two months. This is not grown in Kúlú but in Ládakh; and Zangskár barley sells at 20 seers per rupee.

Lahaul is divided from Kúlú by a range of snowy mountains. It comprises the upper course of the two streams Chandra and Bhága, which uniting under the common name of Chandrabhága, form one of the principal rivers (the Chenáb) of the Punjab. The people belong to a different type of the human race. Their features are essentially Tartar. They speak a language not intelligible to the natives of the neighbouring talooqua of Kúlú. The country is rugged and inhospitable. For six months snow covers the ground. The inhabitants descend to the more genial temperature of Kúlú, and return with the commencement of summer. The soil yields only one crop a year, and the grains produced are buckwheat and barley peculiar to the country. Spiti is a region almost, similar, except perhaps the cold is still more severe and the people less civilized even than in Lahaul. It is surrounded on all sides by lofty mountains inaccessible for half the year, and the mean elevation of the valley (along the river Spiti) is not less than 10,000 feet above the level of the sea. The people belong to a kindred race with those of Lahaul. The language is almost identical, but the customs and religious institutions are not

* The Bunan is a dialect of Tibarskad, spoken in part of Lahaul (see Cunningham's Ládakh, p. 397).

analogous. Here also the resources of the land are locked up for more than six months, in the rigours of winter. The inhabitants are obliged to repair during this inclement season, to the lower and more genial latitudes in the valley of the Sutlej.

The produce of the land in Lahaul and Spiti does not suffice for the wants of the population. The people of Lahaul import grain from Kúlú, and the valley of the Sutlej supplies the additional demands in Spiti. The crops in both talooquas are the same. The barley of Spiti is hexagonal or six-sided, and the grain large and succulent.*

785.—[2880-81]. Series of barleys from the province of Spiti, comprising barley of 1st and 2nd quality. KANGRA LOCAL COMMITTEE.

(2882) Barley, locally called "sowa."

(2883) Ditto, of the sort called "sarmonh."

(2884) Ditto, of the sort called "zei."

786.—[2961]. "Ghoni barley." AMRITSAR LOCAL COMMITTEE.
 Lahore.

787.—[3089]. Jau Arábistán. CHAUDRI IMAM BAKSH of Sanda, near Lahore.

This is a very good barley grown at Sanda, near Lahore, from seed that was obtained from the countries bordering on the Persian Gulf.

788.—[3090]. Paighambri barley. Lahore.

A transparent barley known by its waxy appearance.

Gujranwalla. **789.**—[3168]. Paighambri barley.

Gugaira. **790.**—[3279]. White paighambri barley.

791.—[3280]. Black do., do.

Grows in Manserah and Harappa, producing about 12 maunds per acre.

Dera Ghazi Khan. **792.**—[3386]. Black paighambri barley.

Hazara. **793.**—[3451]. Barley.

A fine grain, having a wax-like appearance and a greenish color.

794.—[3492]. "Karim," or paighambri jau, from Ladakh. H. Kashmir. H. THE MAHARAJAH OF

KASHMIR.

Value, 29 seers per rupee.

795.—[3493]. 2nd quality barley, from Srinagar.

Value, 1 maund 8 seers per rupee.

796.—[3494]. 3rd quality.

Value, 2 maunds per rupee.

OATS.

Botanical name—(*Avena sativa*, L.). Native name—Javi.

These are only exhibited from two districts.

797.—[2654]. Oats, from Ambálah.

798.—[2502]. Oats, grown for Government cattle farm in Hissar.

MAIZE.

Botanical name—(*Zea mays*, L.) Native names—Makai, Challya (in Kangra and Kúlú) Jawár kalán (Persian) Kúkrí.

DR. FORBES' analysis of maize supplied from Bombay is—

Moisture,	12.90
Nitrogenous matter,	9.23
Starchy matter,	74.63
Oily matter,	1.59
Ash mineral constituent,	1.86
	100.00

The young stalks are used as fodder, the parched grain is called "chabina," and eaten; it ripens in the month of Assuh and Kátak, is cut and stacked out about 10 days in the field, and then the cobs are taken off, and beaten to separate the grain.

The varieties of this grain exhibit great difference in size and color, the maize of the plains is generally whitish and very pale yellow, or else deep red; the large grained orange-colored maize is generally grown in or near the hills, but is exhibited of excellent quality for Gujrát and other places.

799.—[]. Indian corn, mostly of the pale yellow sort, and of ordinary quality, is exhibited from Delhi (2538); Gurgaon (Noh-Tahsil), (2564); Rohtak (2609); Ambálah (2669); Ludhiana (2688); Jalandhar (2826); (orange colored "pahári"); Hush-

* BARNES' Settlement Report of the Kangra district.

yarpúr (2902); Gujranwalla (3171); Jihlam (3238); Gugaira (3284); Dera Ismail Khán (3371); Dera Gházi Khán (3394); Bunnoo (3927); Peshawur (3442); Kapurthálla (3471); Kashmír (3493).

MAJOR CLARKE'S account of the cost of cultivating 2 acres with makai, kharif crop, is as follows :—

On 2 acres of maize or makai (produce first rate):—

	R.	A.	P.
Crop, 40 maunds,	26	10	0

Cost.

Government dues, lumberdarí, &c., ...	7	4	9
Seed,	1	0	0
Hand hoeing,	4	0	0

Total Rs., ... 12 4 9

Payment in kind.

	MD.	SRS.
Watchman or bird-keeper,	3	20
Reapers,	1	8
Potter, carpenter, and lohar, each, ...	0	12
Mochí and dharwai, ditto,*	0	12
Chaukidár, barber and dhoobí	0	6
Teli, fakir and mochí, ditto,	0	3
Khákrob,	1	8

Mds. 6, seers 29 = Rs. 5 7 0

Total expenses, Rs., ... 17 11 9

Gross profits, Rs., ... 8 14 3

Maize grows everywhere throughout the hills, and appears to flourish just as well in a temperate as in a tropical climate. At 7,000 feet or at 1,500 feet, it is the favorite crop of the people, and for six months of the year forms their common staple of food. Although superseded in the vallies by the rice, there is always a little plot of maize around the cottage of the peasantry, which is reserved for themselves, while the rice is disposed of to wealthier classes. To the uplands, maize is an admirably suited crop. It is very hardy, requires little rain, and is rapidly matured. In sixty days from the day of sowing, the cobs are fit to eat; but the grain will not keep. Weevils attack it in preference to any other grain, and it is a

popular saying that the life of maize is only a year long. It sells at 30 seers per rupee.

The method of separating the grain is peculiar; the stiff ears of the maize bruise and draw blood from the feet of cattle, so the maize is threshed by men with bamboo sticks. For this purpose the cobs (chuchi) are gathered on the floor in a heap; a screen of blankets is set up round the floor to prevent loss of flying grain, and two or three persons are seated near, to replace in the heap cobs that are thrown out of the range of the blows.

The varieties of maize exhibited, were as follows:—

800.—[2703, 2736, 2748, 3761, 2776]. Orange colored maize from the Simla states, viz., from Bhaji, Bágal, Kothár, Mahlog and Dhámí.

801.—[2838]. Large maize, from Kangra and Kúlú.

802.—[2943, 2957, and 3016]. Yellow, white and red maize. Amritsar district. LOCAL COMMITTEE.

803.—[3095]. Common maize, from Lahore. FAKIR SHAMS-UDDIN.

(3094) Makai pahári (hills).

(2095) Makai Emanábádi (variety).

(2096) Makai Farakhábádi (variety).

These are varieties named after these cities, but grown in the Punjab.

804.—[3208]. Orange colored maize. GUJRAT LOCAL COMMITTEE.

805.—[3209]. Red variety, by the same.

(Makai or maize is not exhibited from any of the dry sandy districts, such as Múltán, Jhang, Gugaira, and Muzaffargarh.)

806.—[3493]. Maize, from Srinagar. H. H. THE MAHARAJAH OF KASHMIR.

807.—[3531-32]. Maize from the Jammú territory, by the same.

RICE-PADDY.

Botanical name—(*Oryza sativa*, L.) Na-

* The village weigher: he weighs out the produce when required for payment in kind or other purpose.

tive names—Dhán or Shálí; and when husked, Cháúwal, and Brinj (Persian); 'Arz (Arabic); boiled rice is called Bhát or Khushká; when bruised, Churwá; when boiled with milk, Khír or Firmí. The names for the different varieties of rice occur in the sequel.

The varieties are almost endless, but there can be no doubt that a large number are in fact synonyms.

Almost every district where there are low lands, which are inundated either by natural or artificial means produces some rice; heavy dákar soil suits it. It is one of those crops that requires raising first in a nursery, after which the seedlings are planted out.

The district of Gugaira produces a considerable amount of rice by artificial irrigation, and profit is derived at the jail from husking the grain by prison labor. But the great rice producing places are Kangra and Peshawur, the former celebrated for its "básmati" rice, which is very largely imported into the plains, and the latter for its celebrated "bára" or scented rice, which is grown on the banks of the river Bára. The special products of each district will receive notice in their proper place in the sequel.

The following extract from MAJOR CLARKE's report, describes the cultivation of rice in the plain districts of the Punjab proper: an account of the hill cultivation is given separately.

"The first step towards the cultivation of rice is to raise seedling beds; the seed should be sown in Har, on a plot of ground well manured but not ploughed, *i. e.*, not too loose. A kanál or one-eighth of an acre takes about three seers of seed; the nursery must be watered every second or third day. In Sawun when the rains have been favorable, the seedlings are transplanted to the 'rohi' land, properly prepared by repeated ploughings and clod crushings; the latter process is not done with the ordinary sohága, but with a dentated one, a kind of harrow, which tears up and clears off obstructing roots and grass. The work of transplanting is sometimes done by the cultivators themselves, sometimes by hired laborers, who are paid by two and a half seers a maund of the produce when ripe. If the

nursery is a good one, eight murlas of plants will suffice for an acre of plantation, the field must be continually flooded, and of course must depend greatly on the rains; when these fail, the crop is watered from a well or pond, or other reservoir; in the latter part of Kartik it ripens, and is reaped by the cultivator—if of small extent by hired laborers; if of large extent—reapers receive two pie or seven seers of grain, or one man's load of the straw and grain for every kanál reaped. When dry enough, the rice is separated from the straw by being trodden out by bullocks, and cattle are fed upon the straw. Where the crop is only on a patch of land, the grain is brushed out by a kind of threshing, or a sohága. Winnowing is paid for at two pie per maund of the paddy winnowed. Various items are claimed by village servants—as blacksmiths, potters, &c.—The average produce per acre, is twelve maunds.

The cost and produce of one acre of rice are as follows:—

	R.	A.	P.
Produce of first rate crop, maunds			
26,	24	0	0
<i>Cost.</i>			
Govt. Revenue, 6 to 8 maunds, say, ..	8	0	0
Lumberdár, patwári, &c., ..	1	2	3
Seed,	0	8	0
Bird keeper, grain (wheat), ..	3	0	0
Reaper, 1 maund 8 seers (rice), ..	1	3	3
Sweeper, 18 seers,	0	7	0
Inferior village servants, including			
15 seers for dharwái, 1 maund 26			
seers = value,	1	10	0
Total expenses, Rs.	15	14	6
Gross profits, Rs.	8	1	6

303.—The following districts exhibited samples of the rice ordinarily grown in the district, as found in the bazars, without specifying any particular variety. Many of the samples were fair rices—of the qualities safeda and samoja.

Delhi (2541); Kapúthalla (3472); Kurnál (rice and paddy), (2588-89); Hissar (Fattihábad), (2591); Rohtak (paddy), variety sáthi (2606). Only one or two varieties are grown in the canal villages. When husked, the grains have a reddish coat: produce 7 to 12 maunds per acre: value unhusked, from 32 seers to 1 maund 10 seers per rupee. Ludhiana (2686); Gujranwalla (3174); Gujrát (3205); produce 14 maunds per acre: price from Rs. 2 to 4 per maund. Jhílam (3237); Dera Ghází Khán (3887-88); Bunnoo (3429); Hazara (Khánpúr) (3460), Shahpúr (Bhera), husked and unhusked,

(3252-53), called Múnji : produce 14 and 15 maunds per acre, of which about half is husk.

The varieties of rice exhibited are as follows :—

809.—[2557]. Dhán (paddy), variety sukhás, from Firozpur Tahsil.
Gurgaon.

810.—[2581]. Dhán, variety sáthi (red skinned) from Rewari tahsil.

811.—[2526-32]. Seven varieties of rice from Sirsa. DEPUTY COMMISSIONER.
Sirsa.

(1) "Son-kharsa" or "kharcha : " sells from 14 to 16 seers per rupee : produce of the paddy from 14 to 15 maunds per begah.

(2) "Kharsú : " value, 27 seers per rupee.

(3) "Pesháwri." This was introduced by Mr. OLIVER, it is considered very superior : at present there is not sufficient for the market, but seeds are kept for the ensuing season. It is grown on the banks of the Ghágar, and lands inundated by it. The produce per begah is about 12 maunds.

(4) "Básmati." This was introduced from the North Western Provinces : it sells from 8 to 9 seers per rupee. The produce per begah is from 13 to 14 maunds.

(5) "Sabzi : " value, 6 to 8 seers rupee.

(6) "Múnji : " value, 18 seers per rupee.

(7) "Sákhánand : " value, 10 seers per rupee.

812.—[2657-59]. Rice of various qualities, from Ambálah. LOCAL COMMITTEE.

1st.—Called "cháñwal, cháñbura : " value, Rs. 4 per maund.

2nd.—Called "Zeri : " Rs. 2-8 per maund.

3rd.—Called "Sathi" (red skinned) : Rs. 1-7 per maund.

The 1st quality is grown especially at Manimájra.

813.—[]. Rice was exhibited from several of the Hill states of Simla.
Simla.

Bhaji, Mahlog, Bágal, &c., &c., the varieties are distinguished by peculiar names, viz.—

"Básmati : " value, 14 seers per rupee.

"Jhinjan : " second quality, value, 16 seers.

"Beháni : " third quality, value, 17 seers.

814.—[2833]. "Básmati" rice (Pálam valley). LOCAL COMMITTEE.
Kangra.

Value, 15 seers per rupee. The yield per begah is about 2½ maunds of husked rice.

815.—[2855]. Specimens of rice in the ear, from the Kangra district. LOCAL COMMITTEE.

The varieties contained in the box are called—Mad-lya malti, Nakandi, Jinwa, Rangari, Gangá jumni, Kotheri, Nakanda, and Kamodh.

It is a common saying in the Kangra district, that there are 360 varieties of rice, and that the subdivisions of the Girth tribe—the usual cultivators of rice—are equally extensive.

The following extract from BARNES' Settlement Report, describes the method of rice cultivation in the Kangra valley :—

"The upper valleys of Kangra are the granaries of rice. Here are combined the abundance of water with high temperature and a peculiar soil, which makes rice so exclusive a product. The people recognize upwards of sixty varieties. The most esteemed kinds are 'begami,' 'básmati,' 'jhinwa,' 'nakanda,' 'kamodh,' 'rangari,' &c. Each of these sorts has a special locality.

"Thus Rihlú is famous for its begami rice, and Pálam for its básmati.

"These are the finest rices. In the more elevated parts of the valleys, a coarser kind is grown. The local names are 'kutheri,' 'kolhena,' &c.

"The irrigated parts of Haripúr and Núrpúr also yield good rice, but not equal to the produce of the upper valleys ; and generally throughout the district wherever the land is fertile and level, rice is cultivated as a rain crop. The varieties sown on the dry lands are coarse and more hardy. The local names are 'rora,' 'kalúna,' 'dhakar,' &c.

"On lands which can command irrigation, the rice is not sown till the beginning of June. In districts dependent upon rain, the seed is thrown into the ground as early as April, and the later the season of sowing the less chance of the crop reaching maturity. The harvest time is during the month of October. There are three modes of culture. Two by sowing the seed, and one by transplanting. The first and simplest is called 'butur.' The seed is sown broadcast in its natural state. On unirrigated lands this is the universal method. The second consists of steeping the seed and forcing it under warm grass to germinate. The seed with the tender shoots is then thrown into the soil, which has previously been flooded to receive it. This method prevails wherever water is abundant, and is called 'much' or 'loonga.' The third is a system of transplanting styled 'aor.' The young plant about a month old is taken and placed out, at stated intervals, in a well-flooded field. This practice involves a good deal of trouble, and is

seldom followed, except in heavy swampy ground where the plough cannot work. The yield of transplanted rice is always greater than under either of the other methods.

"In the month of July the people have a curious way of killing the weeds, which I have never observed in any other part of the country. The crop, weeds and all, is deliberately ploughed up and turned over. Immediately after the operation the whole appears utterly destroyed. But the weeds alone suffer. They are effectually extirpated by this radical process, and the rice springs up again more luxuriantly than ever. This practice is called 'holdna,' the crop is worthless which does not undergo it. Rice is always sown by itself and never mixed.

"The rice is separated from the husk by the use of the hand pestle and mortar; women are usually employed upon this labor, and when working for hire receive one-fourth of the clean rice as their wages. This article is extensively exported, and in the cold season the roads are thronged with droves of oxen, mules, &c., brought up from the Punjab by traders.

"Rice has a very extensive range. In the district of Kangra proper, I have seen it as high as 5,000 feet above the sea. In Kúlú it grows as high as 7,000 feet in the valley of the Beás."

816.—[2886-2892]. Varieties of rice from Kúlú. LOCAL COMMITTEE.

The series consists of the following—Jhinjan, sáthi múshki, and minálu.

817.—[]. Jhinjan rice from Suket. KANGRA COMMITTEE.

Value, 18 seers per rupee.

818.—[2896-2900]. Specimens of rice and paddy of varieties Basmati and munji, from Hushyarpur.

819.—[2933-41, 2979-3008, and 3026-3030]. Series of rices to be had at Amritsar. LOCAL COMMITTEE.

The list contains a very large number of varieties, many of which are imported. But the Amritsar district produces a considerable quantity of rice, and one kind is the "múshkan,"—musk-scented rice, which is supposed after having been kept three years to give out a fragrant odour.

There is a specimen of the paddy and the rice of each variety. The sorts are—

Basmati; Safed basmati; Chhona; Chhona safed; munji.

Sathi, 1st quality (red skinned); so called because it ripens exactly in 60 days (sath).

Sathi, 2nd quality, do.

Sharbati (yellow husked).

Ratua (very similar).

Ratua, 2nd quality.

Dúhni.

Changoa.

Múshkan.

Karhú or Karhsú (inferior).

Bára (imported from Peshawur).

Urár. (The word "urár" implies "this side of the river," hence the term may merely distinguish the place of production of the rice without indicating a variety.)

Begami.

Chinwalál.

Són.

Phat Indar.

Phat Kañguwán.

820.—[3064]. Rice from village Chak-Sealkot. ramdás, Daska.

Price, 12 seers per rupee.

821.—[3065]. Rice, basmati, from Siráñwali village, and Bikapúr of Pasrúr.

10 seers per rupee.

822.—[3060]. Rice from Chakramdás and Bikapúr.

16 seers per rupee.

Sealkot is celebrated for production of rice, but only in a very few localities in the district. At Siráñwali village in the jaghir of Sirdár Mangal Singh, a small quantity of rice is grown, hardly inferior to the famous basmati of Kangra.

The young seedlings after being removed from the bed in which they were sown, are not immediately transplanted as other rices are, but are put into milk and allowed to soak for a fixed period, and then planted out; it is said that this process imparts the whiteness and delicacy for which the rice is noted.

823.—[3074-78 and 3097-102]. Series of rices and paddies found in the Lahore bazar.

Basmati, 1st class; Safeda, 2nd class; Samoja, 3rd class; Chambua (Changúa); Sónpat; Magoi; Bé-gami; Chhóna gol; Sathi; Ratua; Múnji.

824.—[3079-81]. Rices grown in villages along the banks of the Raví. DR. FARQUHAR.

Viz., from Sidhoteri, Khosi, &c.

825.—[3281-85]. Four varieties of rice from Syadwalla, &c. **GUGAIRA LOCAL COMMITTEE.**

Múskan; Sonpattar; Safeda; Chanwa lál (probably equal to sathi).

Rice is entirely confined to two localities, viz., the Degh river and Khanawa canal. The Zemindars not only believe that this grain must be raised on the banks of a canal, which supplies constant and abundant irrigation, but fancy that the water obtained from wells is not sufficiently fertilizing, or "fat" as they express it for this purpose. The quality of the crop, however, on the Kanawa canal is very inferior, a circumstance more attributable in all probability to the negligence and unskilfulness of the cultivators, than to any defect of the soil, or inferior quality of the water.

Some attempts were made to improve the rice by distributing a small quantity of superior seed obtained from Peshawur, but the produce though good for the first year, is said to have speedily degenerated. The rice produced on the Degh nullah is of good quality, and a peculiar description of it, called "múshkun," from a pleasant perfume which it is supposed by the natives to possess,* (but which I confess, I have never been able to discover myself,) is well known and appreciated in this part of the Punjab.

The local consumption of this grain is very limited, but considerable quantities are exported to Lahore. About 30,000 acres are under rice cultivation in this district, and the produce may be estimated at about 4,00,000 maunds.†

826.—[3432-33]. Bára rice, husked and unhusked. **PESHAWUR LOCAL COMMITTEE.**

This is the principal exported variety, and is highly prized for its fragrance; it sells at a high rate, sometimes as much as a rupee per seer. The quantity produced is very limited, probably not more than 20 maunds in a year. It is exclusively grown on lands irrigated by the river Bára, in the Peshawur valley.

In the Sikh times the produce at harvest time was divided into three portions—the best was reserved as seed to perpetuate the stock; the 2nd best share was sent to Lahore for consumption of the court and nobles; the 3rd or worst share was left for the Zemindars to dispose of as they pleased.

* The rice does not acquire fragrance on its first being gathered, but after having been kept three years it is supposed to attain it—a distinction is made in the market between "nava múshkan," "new grain" and the old, which has attained its fragrant property.—E. P.

† Gugaira Settlement Report—ELPHINSTONE.

The cultivation of the rice has very much fallen off from what it was in Sikh times, but then the Zemindars were encouraged by Government to produce, had a certainty of realizing a high price, and officers were appointed to superintend the cultivation, and thus there was an inducement, which does not now exist, to overcome the great difficulties of cultivation, and apply the constant care necessary for a successful crop. Ground to the extent of 290 jaribs was cultivated in Sikh time, at present only 60 jaribs are sown: it is now produced only at villages Shekhan, Mosteizai, and Garhi-Malhi-khail in the Mohmand Tappah. The yield per jarib is from 5 to 6 maunds of the best bára rice.

Besides this rice there are several varieties grown on land irrigated by the Kábul, Swat and Bára rivers, in the valley. They are—

"Doába" (so called from the pergunah Doába, where it grows): sells at 3 seers per rupee.

"Shogha," " 10 seers per rupee.

"Zafráni," " 10 seers do.

"Kunér," " 8 seers do.; grown at Kunér.

"Brinj luk," or coarse rice: * 14 seers per rupee.

"Jyotshi," 10 seers do.

The shoga and zafráni rices produce from 10 to 12 maunds per jarib, and "luk," from 13 to 14.

827.—[3506-3510]. Five varieties of rice. **Kashmír, H. H. THE MAHARAJAH.**

Rice is extensively cultivated in Kashmír, and is of excellent quality. It has as in Peshawur and Kangra the benefit of the irrigation of hill streams. Rice forms the principal food of the people, together with pulses to a certain extent. Wheat appears to be very seldom used.

The exhibited varieties were:—

"Básmati:" which sells at 36 seers per rupee (the paddy).

"Básmati," 2nd quality: 1 maund per rupee (the paddy).

"Sukhdás:" 1 maund of the paddy for 10 annas.

"Kanu."

"Shirwál."

These are the produce of Jammú, and also Srínagar.

828.—[3768-69]. Two qualities of rice. **H. H. THE RAJAH OF JHIND.**

829.—[3775-76]. Two varieties of rice. "Sháli sathi," "sháli zin." **H. H. THE RAJAH OF NABHA.**

* The term "luk" is also applied to coarse grass. In Bunnoo "kunder" has a similar signification.

II. MILLETS.

Millets are extensively used as food, they are principally cultivated for the kharif harvest, and are ripe in the autumn.

GREAT MILLET—JAWAR.

830.—Botanical name, *Holcus sorghum*, *Sorghum vulgare*; also called Jawár Khúrd or Barik.

There are two varieties, one with a reddish grain and one white: in districts where makai (maize) is called "bara jawár," this plant is called "chota jawár" or "jawár bárík." When jawár is used for fodder and cut down while green it is called "chari." When sown for fodder it is much more thickly sown than when grown as a grain: in the former case 50 seers of seed are required to sow an acre; in the latter only 10; manure is given to this crop.

The cost and produce of four acres of jawár, may be estimated as follows:—

Produce.	R.	A.	P.	Cost.	R.	A.	P.
First class, 32 maunds,	21	5	0	Government reve- nue,	5	5	0
				Lumberdar (head- man's fees), ..	0	4	3
				Seed, 32 seers, ..	4	0	0
				Reaper, 4 maunds and 32 seers, ..	3	3	0
				Sweeper, 3 mds. 20 seers,	2	5	0
				Hand-hoeing, ..	4	0	0
				Inferior village servants, 3 mds. 36 seers,	2	9	9
				Total expenses, Rs.,	22	3	0
	21	5	0				

These results do not show a money profit, but if the cultivator has the seed and does the hoeing himself then the case is different. If grown for fodder the cost is much less, and jawár does not always need hoeing. In the tabular list of Lahore produce, before given, jawár is marked as not requiring to be hoed.

Most districts sent jawár, as—Delhi (2537); Gurgaon (2575); Hissar (2593); Sirsa (2635); Ambálah (2656); Ludhiana (2689); Simla (Mahlog) (2762); Jalandhar (2827); Lahore (3068); Gujranwalla (3172); Gujrat (3210); Jhilam (3239); Shahpúr (3258); Dera Ismail Khán (3309); Dera Gházi Khán (3390); Bunnoo (3428); Kapúthalla

(3471). Amritsar exhibited both red and white varieties of the millet, as also Gugaira (3285-86), and Muzaffargarh (3325).

IMPHI—JAWAR WILAYITI.

831.—Botanical name, *Sorghum saccharatum*—Chinese sugar-cane, "*sorgo sucré*."

Only two samples of this grain are exhibited, Rohtak (2608), Kangra (2841).

In the Kangra district it is used as a valuable fodder for cattle, which indeed, notwithstanding the statement in the subjoined extract, appears to be its principal value, as it can be cut down, three or four times a year, and it sprouts again.

The Rohtak sample is probably only a variety of jawár, it forms when cut up a fodder for cattle called "karbi," and its grain is used as a porridge, and also made into cakes: it is extensively cultivated. This description answers better to jawár (*Holcus sorghum*).

The following extract was published by the Financial Commissioner in his Circulars, Nos. 105 and 112 of 1859.

"This plant is attracting much attention in France and the United States. As a forage plant, it is said to be unsurpassed. It readily hybridizes with its congeners and varieties, so it should not be sown near a similar plant. It can be cultivated wherever corn is.

"There are some 30 species of *sorghum*, but some only contain saccharine matter.

"The juice affords sugar, alcohol, and a liquor like cider.

"It is planted in drills about 3 or 4 feet apart, the stalks grow about 2 feet apart. It sends up new shoots after being cut, so that three crops per year proceed from one plant. In a tropical climate it becomes a perennial. It makes a fifth to a fourth of its bulk in good syrup.

"When the seed becomes quite ripe, the fodder is pulled and seed heads cut; the yield of fodder per acre is 1,100 to 1,300; the yield of seed 2536 bushels. On first trial 70 average canes gave 20 quarts of juice, 606 average canes passed once through the rollers gave 38 gallons 1 quart of juice, and a second time 2 gallons of juice. The 40 gallons 1 quart so obtained yielding 8 gallons thick syrup."

The cultivation of the plant was attempted in the the Sealkot district; and in 1862, on the occasion of the distribution of flax prizes, some fine samples of imphi were brought in by several landowners: the cultivation was subsequently discouraged, as the crop was not found in practice to be very successful.



CHINAN, OR ARZAN.

834.—Botanical name, *Panicum miliaceum*, Willd.

KANGNI-ITALIAN MILLET.

This millet is cultivated in both harvests. The grain is much used in the Punjab for feeding poultry, &c. It is very little used as food otherwise; when ripe the grain is shaken out into small pits smoothly "leped" or plastered with mud inside; sometimes it is trodden out by cattle; the straw serves occasionally as fodder. As a food it is nutritious, but is said to be heating and apt to produce diarrhoea. Specimens were sent from the following districts:—

(2847) Kangra.

These series of millets when husked and ready for use, are called chánwál, with the distinctive name added. Specimens were sent from—

Muzaffargarh, where it is called "gall."

(3512) Kashmir.

Its cultivation and mode of threshing, and properties as a grain are similar to the last.

Samples were exhibited from the following districts, there is little difference in the samples except that some are larger, more glossy and yellower than others. In the Muzaffargarh district, it is noticed as much consumed by the Musulman population; it sells at 1 maund 5 seers per rupee. Specimens were exhibited from

Gurgaon (2582); Ambálah (2661); Kumharsen, Simla (2729); Balsan, do. (2799); Kangra (2846); Kálá (2891); Hushyarpár (2906); Lahore (3104); Gujranawalla (3184); Gujrát (3219); Gugaira (3289).

BARTL.

835.—Botanical name, *Panicum brizoides*.
From Palwal. DEPUTY COMMISSIONER,
GURGAON.

This is the only sample exhibited; the grain is quite uncommon in the Punjab.

SAWANK.

836.—Botanical name, *Oplismenum frumentaceum*, Rox. Synonyms—Samáuk, Karín (Kashmír).

This grain is less commonly cultivated than chinā. There is also a wild species found (*Panicum colonum*); it is very little used by the inhabitants of the Punjab proper, except by Hindūs, who eat it on fast days—the “ekādashi,” and 11th day of the moon’s increase and decrease. Darāū (buckwheat) and singhāra or sīl may be eaten also in those days, but not wheat or cereals.

Samples are sent from—

(2547) Delhi.

(2578) Gurgaon.

(2699) Hissar, where it is called a grass in the district list.

(2663) Ambālah, accompanied by a sample of the husked grain.

Bhaji, of Simla (2706); Bagal, do. (2737); Mahlog, do. (2765); Hushyarpūr (2909); Amritsar (2970-3009), had a sample of the husked grain; Lahore (3080-3082), both the whole grain and the ground grain or “rice;” Gujranwalla (3181); Shahpūr (3256); Gugaira (3290); Muzaffargarh (2337); Dera Ghāzi Khān (3402); Kashmir (3523).

BAJRA—SPIKED MILLET.

837.—Botanical name, *Penicillaria spicata*, Wild.; *Holcus spicatus*, L.)

Grown at both harvests, but principally at the kharif: like the other millets it is said to be heating and to produce diarrhoea: it is a superior grain to the last and more often met with. The stalk is useless as fodder when dry, but cattle are sometimes fed on the young crops as it stands.

It is eaten most in the cold weather as flour, and made up into “roties,” and occasionally with buttermilk: its grain is much consumed in the districts between the Jhīlam and Indus, called generically “pahwar.”

Samples are sent from:—

Delhi (2538); Gurgaon (2559); Hissar (2624); Rohtak (2610); Sirsa (2634), price 1 maund 10 seers per rupee; Ambālah (2655); Ludhiana (2685); Kangra (2840); Hushyarpūr (2907); Lahore (3105); Amritsar (2968); Gujranwalla (3173); Gujrat (3211); Jhīlam (3240); Shahpūr (3257); Gugaira (3287); Muzaffargarh (3336); Dera Ismail Khān (3360); Dera Ghāzi Khān (3389); Peshawur (3443); Kashmir, Jammū, (3489); Simla, (2963); Mahlog. This grain seems to be uncommon in the hills; none of the other Simla States send specimens.

BARNES, writing of the Kangra districts, observes that he never saw it in the hills, and only on the southern part of Nārpūr, where the hill verges on the plains.

KODRA.

838.—Botanical name, *Paspalum scorbi-
culatum*, L.) Synonym—Kodoū.

This is not a very common grain, nor has it any qualities to recommend the extension of its cultivation. There is also a confusion of name between the millet and the one following. *Koda* is another name for *mandwa*, and hence a confusion is likely to result between *kodra* and *koda*. Some of the Simla samples called by the name, should be referred to *mandwa*. In the Bijour district writes DR. STEWART: “Kodra is said to produce cholera and vomiting, and I find that some authors mention a similar phenomenon as occasionally occurring in all three presidencies. The natives generally hold that with the ordinary kodra and undistinguishable from it, grows a kind they call majna or majni, which produces the above effects, but it has been with greater probability suggested, that these depend on the use of the new grain under certain conditions. These results, however, cannot be common here, as a very intelligent old gentleman of the district informed me that he has never seen a case.”

Kodra is exhibited as follows:—

Gurgaon (2576).

Bhaji of Simla (2704).

Mahlog, do. (2764).

Bāgal, do. (6738).

Balsan, do. (2801).

Ambālah (2664), where only a very little is produced.

Kangra and Kalū (2848).

Hushyarpūr (2905).

Amritsar (2971).

Gujrat (3222).

Kashmir, Srinagar (3522).

MANDWA.

839.—Botanical name, *Eleusine coraca-
na*, Gaert.) Synonyms—Mandal, Marwa, Chalodra. Koda (in the hills).

This is principally a hill product, but is also cultivated in Sealkot and other districts. In Lahore however a sample is obtained with some difficulty; this grain is never attacked by insects, and will keep any length of time. The haulm or stalk, which is flat, is so exceedingly tough and strong, that the crop is gathered in by plucking off the heads, and leaving the stalk standing.

Samples are sent from Gurgaon (2558).

Kangra hills (2845). The produce in this district

* Food of the people of Bijour.

exhibited 2½ maunds per begah. The Local Committee remarks of this and other millets in the Kangra district, that they form an important part of the food of the people.

Ambálah (2662).

Bhaji, Simla (2707).

Kumharsen, do. (2727).

Bágal, do. (2738).

Kothar, do. (2750).

Hushyarpúr (2910).

Lahore (3106).

This grain is exhibited under the name chalo-dra, from Kashmir (3497); and Gujrát (3207).

In this class it may be proper to include several doubtful grains which are wild, and are used occasionally as food: in appearance they resemble millets. They are:—

840.—[2646]. “Samák,” wild sawánk (*Panicum colonum*), from Sirsa.

841.—[2649]. Phog. Sirsa.

842.—[2344]. “Tánk.” Kangra and Kúlú.

843.—[3403]. “Koreah.” Dera Ghá-zí Khán.

Both these last are wild grains, probably species of *Panicum* (as *P. colonum*). Price, 25 seers per rupee.

III. PULSES.

This class of produce shows more variety than any of the foregoing; there are some common pulses, which are grown in almost all districts alike, but there are others which are peculiar to certain districts; the synonyms in this class are interesting, the collection on the whole in this department was full and satisfactory.

Most of the pulses are used when the seed is split, and forms what is called dāl. There is *dāl masúr*, *dāl urad*, *dāl mung*, &c., implying split lentils, split urd, &c., &c. They are much eaten by the natives boiled, either alone or with rice, and cooked with oil or ghi, red pepper, &c., &c. Some kinds are eaten boiled while green, as “*tarkári*,” vegetables. Gram (*chola*) is eaten parched, or it is ground into a flour called *besan*: it forms also the principal food of horses and goats.

Másh, mung and channa (gram), are the pulses most in use, but some of them are said to produce flatulence and colic. *Churál* is said to be hard and

indigestible. *Raván*, *bákla lobya*, and *gunér* are less common, and are not grown at all in many districts.

MUNG.

844.—Botanical name, *Phaseolus mungo*, L.; *Phaseolus Max*, W.

A kharif crop, entirely dependent on rain, is not suited to low-lying or inundated lands, but grows in bangar and bar edge lands. This is the “green gram,” and there is also a black variety which is called *Ph. Max*, but the green is far the commonest in this province.

Mung was exhibited as follows:—

Delhi (2564); Gurgaon (2552); Rohtak (2613); Sirsa (2626), where it sells for 1 maund per rupee; Ambálah (2670); Ludhiana (2694); Simla States, Bhaji (2714); Kothi (2792); Kangra (2854); Amritsar (2952-53), with a specimen of the dāl of mung; Lahore (3123-25), both the black and green varieties, with dāl of the same; Gujranwalla (3176); Gujrát (3212); Jhilm (3244); Shahpúr (2260); Gugaira (3292); Muzaffargarh (3345); Dera Ismail Khán, (3362); Dera Gházi Khán (3425); Bunnoo (3398); Peshawur (3954); Kashmir (3434-35); Jammú territory.

SAFED MUNG.

845 —Botanical name, *Phaseolus aureus*.

This grain is a mere variety; uncommon however.

MASH.

846.—Botanical name, *Phaseolus Roxburghii*, W. & A.; *Phaseolus radiatus*, Rox. Synonyms—Másh, Urd, Máñh, (Karothei, Kashmir).

This is grown extensively on sailabi land as a kharif crop. The stalk is excellent fodder, and the grain is said not to be attacked by insects. ROXBURGH remarks that it is the most esteemed of the *Leguminosae* and bears the highest price. DR. ROYLE says that the root contains a narcotic principle. There are two varieties, black and green.

Specimens were sent from—Delhi (2542); Gurgaon, both varieties, (2559-60); Rohtak (2614); Ambálah (2671); Ludhiana (2693). The Simla Hill States as follows:—Bhaji (2713); Bhagal (2741).

Kothár (2753 A).

Mahlog (2767).

Dhámí (2775).

Júbál (2788).

Koti (2790).

Balsan (2803).

Jálandhar, Nawáshahr, (2828).

Kangra (2851).

Máh is the best of pulse crops in this district : it is often grown along with kúlth (*Dolichos uniflorus*, W). The produce of this crop is eaten and called "mah chapal;" the produce of máh per beegah is about 12 maunds.

Hushyarpúr (2917).

Amritsar, both varieties, with the dál of each kind (2945-49).

Lahore, a similar series (3117-20).

Gujranwalla (3177).

Gujrát (3214).

Jihlam (3243).

Bunnoo (3426).

Rawalpindi (3194).

Shahpúr, Khusháb (3259).

Gugaira (3291).

Muzaffargarh (3393). Value, 18 seers per rupee.

Dera Ismail Khán (3367).

Dera Gházi Khán (3405).

Peshawur (3452-53), both varieties.

Kashmír, both varieties, one of them marked "másh safed" (3538-40). Black másh is called in Kashmír "karóthi."

Nabba (3783).

Jhind (3771).

MOTH.

847.—Botanical name, *Phaseolus aconitifolius*, Jacq.

This is a kharif pulse unsuited for growth on sailabi land, but well grown on any other. It is dependent on rain for its growth; and is reckoned inferior as a pulse to the foregoing species of *Phaseolus*. The leaves of the plant are deeply indented like those of the aconite, hence its botanic name of *Aconitifolius*.

Specimens were sent from :—

Delhi (2545); Gurgaon (2580); Hissar (2596); Rohtak (2615); Sirsa (2635), where it sells at 1 maund 5 seers per rupee; Ambálah (2678); Ludhiana (2692); Hushyarpúr (2916); Amritsar (2954-57); exhibits both "safed moth" and dál made of moth; Lahore (3120); Gujranwalla (3178); Gujrát, moth "safed" (32); Sirsa (3215-16); Jihlam (3245); Shahpúr (3262); Gugaira (3293); Muzaffargarh (3346); Dera Ismail Khán (3361); Dera Gházi Khán (3396); Peshawur (3545); Kashmír (3537); Jammú territory (3543).

848.—JAMESON gives another *phaseolus* viz., *Ph. torosus*, under the name of "ghurúsh," in the Kangra valley.*

GUAR.

849.—Botanical name, *Oyamopsis psoraleoides*, De C.; *Dolichos psoraleoides*, Lam.;

Dolichos fabaformis, Wild.

This is not a common pulse in the Punjab. It is distinguished by its pale grayish color.

It appears that guár is almost exclusively cultivated in those parts of the province that were formerly in the North Western Provinces; where it is also called guár mung. Gujrát is the only district in the Punjab proper which exhibits a sample: the pulse is stated by the Rohtak Local Committee to be made into dál, but to be used principally for cattle; it is boiled in a pan and then the grains are rubbed and worked about with the hand till a froth rises on the mass: a little mustard seed oil is then added; it is given to cattle to fatten them.

Samples appeared in the collections of Delhi (2546) Gurgaon, Rewari, (2548); Hissar; where it is called guár mung (2594); Rohtak (2616); Sirsa (2638); where it sells for 1 maund 15 seers per rupee; Gujrát (3216).

GRAM OR CHANNA, OR CHOLA.

850.—Botanical name, *Cicer arietinum*, L. Synonyms—Bengal gram, Chick pea—Chola—Nakhúd, (Per.), Humúz (Ar.)

The grain has a peculiar shape, being partly spherical, but with one side pulled out into a point. PLINY, in describing the variety, says it is in the shape of a ram's head, whence it is called now *C. arietinum*.

The plant is said to produce oxalic acid, and in some places cloths are spread out at night over a growing field of gram: the dew falls and becoming impregnated with the oxalic acid of the plant, is absorbed by the cloths; these are wrung out into a vessel, and the liquid drunk as a cooling beverage. This is not done however, as far as I am aware, in the Punjab. The natives often eat the grain parched under the name of chabina; I have seen it eaten in the same way in Egypt.

Gram is a rabi crop: after cutting in Baisakh it is left several days in the field to dry, and is eventually trodden out by cattle. The grain is remarkable for the small proportion of nitrogenous matter it contains, as compared with *Lathyrus* and other species.

This does not appear to be a pulse grain of the hills. None of the Simla States but Mahlog, Kothár and Sirmúr exhibit it, and kulthi (*Dolichos uniflorus*) seems to take its place in Kangra in which district it is not produced except at a few places.

The gram or chick pea is never grown in the Kangra pergunah, and is scarce in Haripúr. Nadaun and Núrúp are its chief localities. There is a belief current in the hills, says BARNES, that there is some

* Agri. Hort Soc. Journal, Vol. viii., p. 185. (Correspondence and Selections).

affinity "in the grain field which attracts the lightning, and after a storm I have certainly observed whole tracts scorched and destroyed as if by fire."*

There are several varieties—(1), The ordinary gram, yellow with brown or reddish brown skin; (2), Kábuli or white gram, being of a pale stone color, sometimes with a coat of red as in the Muzaffargarh sample, and has the pointed prominence less developed; (3), Black, with husk quite black.

The ordinary grain was sent from Delhi (2545); Gurgaon (Jhassa), (2573); Karnál (2540); Hissar (2594), Rohtak (2612); Simla States—Kothar (2754), Mahlog (2766); Sirmúr (2787); Jálándhar (2824).

Kangra sends a sample which is remarkable as having been grown in Kúlú (2849); Hushyarpúr (2911); Sealkot (3067); Gujranwalla (3175); Rawalpindi, white variety (3193); Jhílam (3241); Shahpúr (3264); Gugaira (3295); Dera Gházi Khán (3393); Kapúthalla (3478); Kashmir (Jammú), two varieties, (3354-55); Dera Ismail Khán, two varieties (3357-58).

Ambáláh (2665-67), three varieties—the black, white, and ordinary.

Amritsar (2949-50-51, 3032, 3040-42), exhibits all the varieties, including "dál."

Lahore (3109-12), white, Kábuli, and ordinary.

Gujrát (3203-4), gram and Kábuli gram.

Local Committee, Muzaffargarh (3340-42) three varieties—white, ordinary, and Kábuli, with a reddish tinge.

Local Committee, Peshawur (3449-50)—1, ordinary gram; and 2, the genuine Kábuli variety, brought across the frontier.

LENTILS OR MASUR.

851.—Botanical name, *Ervum lens*, L., *Cicer lens*, Wild. Synonyms—Masúr, Mauri, Micer (Dera Gházi Khán), 'Adas (Arab).

This is the lentil or red pottage, the flour of which, says DR. BIRDWOOD, makes the Revalenta Arabica, the name of which is nothing more than a juggle of the words *Ervum lens*: "notwithstanding the illustrated advertisement of negroes digging at the roots of strange palms." The pulse is used as a dál, but is said to be heating and produce eruptions if too freely indulged in.

Specimens were shown by the following districts, Gurgaon (2563); Ambáláh (the dál), (2672); Simla States—some of the samples are very dark colored—Bhaji (2715); Koti (2755); Kunyár (2781); Balsan (2802); Tiroch (2815); Hushyarpúr (2914); Amritsar (2950); Gujranwalla (3719); Lahore (3113) with dál (3114); Gujrát (3213); Jhílam (3242); Shahpúr (Khusháb), (3261); Gugaira (3294); Muzaffargarh

(3348); where its price is 32 seers per rupee. Dera Ismail Khán (dál), (3364); Dera Gházi Khán (3394); Peshawur (3347-48), a dark skinned variety, and "dál Kashmir" (3515), from Srinagar.

KULTHI.

852.—Botanical name, *Dolichos uniflorus*, Lam.; *Dolichos biflorus*, Wild.) Synonyms—Madras horse gram, Kulth.

This is a grain which is very little grown in the plains, but appears to be common in the hills; almost every one of the Simla Hill states exhibited a sample. It is the poorest kind of pulse, and grows on high meagre soils. It is in Kangra sown with "máh;" the only observable difference in the samples is, that some of them have the outward skin much darker brown than others, being almost black. Some specimens were sent prepared as a dál for human food. The grain is hard and indigestible, mottled with specks of darker color. Samples were shown from the following districts:—

Ambáláh (2675); Simla States—Bhaji (2711); Kumharsen (2732); Bagal (2740); Kothí (2753); Mahlog (2768); Kothar (2793); Kangra (2850); Hushyarpúr (2913); Amritsar (3044-45), exhibited both the grain and dál made of it.

RAWAN.

853.—Botanical name, *Dolichos sinensis*, L. Synonyms—Lobiya (Shahpúr district), Harwáñh chota (Amritsar), Rawangan (Simla), Raoñgi, Rawáñgi (Kangra), Rawáñh reddish variety, (Gujranwalla, Jálándhar), Ro-ñi, (Amritsar); probably some of the varieties called *Dolichos catjang*, W., are included in these.

There were three beans in the collection, and a fourth, which is in the catalogue, I could not find; the specimens all bear the name of rawáñh, with or without a qualifying epithet, such as *safed*, *siyah*, &c., are also called rawáñgi in Kangra, and rawáñgan in Simla, which forms a diminutive of rawáñh and equivalent to chota rawáñh.

I. There is a whitish oblong truncated bean almost one-fourth inch long, and one-eighth inch broad, having a clear white eye surrounded by an irregular black line: this is called rawáñh chota safed; rawáñgi or ruoñgi and lobiya. This is perhaps *Dolichos catjang*.

It is exhibited by Simla, Bagal (rawangan), (2742); Kangra (reoñgi), (2856); Amritsar (rawáñh chota safed), (3050); and (3261) from Khusháb in Shahpúr district (lobiya).

* Settlement Report of Kangra District, p. 56.

II. This variety is exactly the same in shape and size, and has the white eye surrounded by a black line but the bean is *red, or reddish-brown*. It is exhibited by—Lahore (3116); Gujranwalla (3180); and Muzaffargarh (3344); as rawān, without any qualifying epithet, probably it is the only variety known in these districts. The Amritsar specimen (2965) is called “rawān surkh.” The Kangra sample (2856), included in the first variety may be also put in the lot, as the sample has a mixture of the two, white and brown. Jalandhar produces a similar red bean called rawān; samples of rawān came both from Dera Ismail Khān and Dera Ghāzī Khān (3365 and 3397), but they escaped notice, and I am unable to say to which variety they belong.

III. This variety is just like No. I, except in size, it is much larger, and the black band round the eye (which is the distinguishing mark of these varieties) much more broadly developed. It is the *Dolichos sinensis*. Two samples are sent, both called rawān. The same districts, which called this variety rawān, call the other varieties rawāngi, rawān safed chota, &c.; in those districts, which call the small brown variety, rawān, without any epithet added, this variety is unknown, or would be called lobya. Specimens were sent from Kangra (2855); Amritsar (2964); I believe also from Bunnoo (3429); Peshawur (3451); both called lobya.

IV. Harwāh siya, the black variety, is sent from Amritsar (3098). This I take to be black seeded *Dolichos*.

BAKLA.

854.—[3456]. Bakla, garden bean, (*Vicia faba*, *Faba major*). From Peshawur (kābli bakla) and Kashmīr.

A darker colored bean, but otherwise quite similar 3488 (bakla.)

Bakla, and a bean called sawāwa, are mentioned as pulses of Hazara, but no specimens were sent.

LOBIYA.

855.—[3530]. Botanical name, *Phaseolus vulgaris*, L.; *Ph. lunatus*, L. Red and white haricot beans (mixed) are exhibited from Srinagar, Kashmīr: called in Kashmīr dhākh.

KEO.

856.—Keo, káiún or káli múnq? (*Dolichos lablab*?)

A dark-brown or black seed, not flattened but round and full truncated oval, having the eye the same color as the body, and situated at the end and not at

the side like the *Phaseoli*. A sample was sent from Hushyarpúr (2912); Gujrāt (3218).

MATTAR.

857.—Mattar, field pea (*Pisum arvense*, W.) Synonym—Matar Rewari (Amritsar) Karaiñ (Gujrāt and Kashmīr), Kulāwāñ (Simla), Mattar Kāla (Kangra).

Exhibited from Ambālah (2668); Simla, Balsan (2804); (kulāwāñ) Kangra (2857); (mattar kāla) (2876). Amritsar, mattar and mattar rewari (the latter specimen is much mixed with chural (3037-3039); Gujrāt (3221); (karaiñ) Dera Ghāzī Khān (3395); Gugaira (3296); Muzaffargarh (3346); Peshawur (3446); Kashmīr (3591-92); from Srinagar and Jammu.

MATTAR BARA.

858.—Mattar bāra (*Pisum sativum*, W.)

This is the common pea familiar in Europe, it appears to be but little grown in the Punjab: there are only two samples from Delhi and Amritsar, both whole and split (2961-62).

CHURAL.

859.—Churāl (*Lathyrus sativus*).

The grain is gray colored with minute specks of black, also a thin line of black passes all round the seed as if to separate it into two halves. The shape is highly irregular, scarcely two seeds are the same, but the general characteristic is that the seed is wedge-shaped, being attached to the pod at the end of the thickest side. It is used as a pulse, being made into dāl, but is hard and indigestible.

The specimens are as follows:—

Amritsar (3038); Lahore (3127); with dāl of do. (3128).

860.—Múnq Ladākhi (*Cicer sp* ——— ?)

This is a unique specimen sent from Ladākh, by H. H. THE MAHARAJA OF KASHMIR (3536); it is not “múnq,” and has the pointed seed which indicates it to be a *Cicer*; it is not unlike gram in shape, but is very much smaller and is of dark brown color. Its selling price is 32 seers per rupee.

ARHAR.

861.—Botanical name, *Cajanus flavus*; *Cytisus cajan*, Wild; *Cajanus indicus*, Spreng. Called also kohlú or kehú (Simla States), dāngri (Gujrāt), and dhingra, or kúndi in Kangra.

A less esteemed pulse than the others: it is said to be liable to produce costiveness. DRURY, however, mentions that natives esteem this plant third in the order of the Leguminous grains.