

UNIVERSITY OF CALCUTTA.

**REPORT OF THE COMMITTEE APPOINTED TO CONSIDER THE
BEST MODE OF INTRODUCING THE STUDY OF
NATURAL AND PHYSICAL SCIENCE INTO
SCHOOLS AND COLLEGES IN INDIA.**



**OPINIONS OF EDUCATIONAL OFFICERS AND OTHER GENTLE-
MEN ON THE PROPOSALS CONTAINED IN THE
COMMITTEE'S REPORT.**

CALCUTTA:

PRINTED AT THE HOME SECRETARIAT PRESS,

1871.

**REPORT OF A COMMITTEE APPOINTED BY THE SYNDICATE TO REPORT
ON THE BEST MODE OF INTRODUCING THE STUDY OF
NATURAL AND PHYSICAL SCIENCE INTO
SCHOOLS AND COLLEGES IN INDIA.**

IN responding to the request of the Syndicate to draw up a scheme for the introduction of Natural and Physical Science into Schools and Colleges in India, the Committee have endeavoured to fulfil two fundamental conditions. The first and most essential is, that the execution of the scheme shall be *practicable*; the second, which is only second in importance, is that it shall involve teaching of a *practical* character, that it shall inculcate a knowledge of things in contradistinction to mere book knowledge, and that it shall be directed to developing and training the powers of observation rather than those of mere memory.

The Committee are fully aware that most of the difficulties that will have to be met in carrying out the scheme now proposed, will be owing to the enforced observance of this latter condition; but they hold that these difficulties must be met and overcome, at whatever cost of exertion and pecuniary outlay, if the teaching in Physical Science is to fulfil its main object, and is not to degenerate into a mere art of reproducing words and phrases which in the learner's mind are not clearly associated with their appropriate external objects.

In selecting the subjects of examination, the Committee have, as far as possible, given preference to those which can be illustrated by experiment in the class-room; or the materials of which, as in the case of plants, are easily procurable; or which, finally, can be treated with special reference to India.

It has been considered of more importance to bring the objective character of the sciences *home* to the students' minds than to adhere to a logical sequence of subjects, and hence the scheme may seem to be fragmentary and unsymmetrical if regarded as a course of Natural and Physical Science. Several subjects that would find their place in such a course have been altogether omitted from the Committee's scheme, since their teaching is not compatible with one or other of the two fundamental conditions already specified. Dynamics, for example, is omitted owing to the difficulty of its elementary conceptions, and because the experiments which are required to render these clear are difficult to carry out; and frictional electricity is omitted from the school course in consideration of the difficulty attending its experimental illustration in the Lower Provinces during the greater part of the year owing to the dampness of the climate.

One of the subjects which it is proposed to introduce may, at first sight, seem somewhat foreign to the purpose. The art of drawing, it may be objected, is no part of either Natural or Physical Science; and its introduction into the general course for the Arts Degree may seem to be an innovation beyond what was contemplated in the appointment of the Committee. It seems desirable, therefore, to state the reasons which have influenced the Committee in making this subject an integral part of their scheme.

To prevent misconception, it must be stated at the outset that it is proposed to limit the teaching under this head to the representation in outline of simple forms, *viz.*, geometrical drawing, with the projection of simple objects, and free hand-drawing in outline. It has been premised that one of the principal objects of the scheme is to ensure the cultivation of the observing faculty, and, as regards the observation of form and proportion, no subject of instruction appears so well fitted for the purpose as the practice of elementary drawing in outline. Any naturalist will readily bear witness to the truth of this; and, in a recent writing, the Astronomer, Mr. T. W. Webb, expresses his regret that a certain amount of artistic skill is not considered absolutely necessary in a liberal education, and argues that the advantage

and pleasure derivable from it in after-life are, so obvious that time now spent in mastering other subjects might be better expended in acquiring the most useful art of design. Another most important advantage of this kind of instruction is, that it greatly facilitates all conceptions relating to space. In teaching mathematics to Bengali students, the greatest difficulty has been experienced in getting them to comprehend the most elementary propositions concerning lines out of one plane. They cannot see that a circle projects into an ellipse, or that when a rectangular box is drawn in perspective, all the angles at one corner of it are not projected into right angles. For these and similar prejudices of the mind, a practical knowledge of perspective affords a simple and valuable corrective. As an auxiliary, therefore, to the teaching of science, drawing must be conceded to have a very high value, and it is as an auxiliary that it claims a place in the present scheme. Of the importance of drawing in general education, of the additional power of describing objects or conceptions which it confers on those who possess it even in a very moderate degree, it is unnecessary here to speak; but such considerations may be allowed due weight in estimating its claims to be admitted into a course of liberal education. As a preparation for practical Geometry, it is proposed to require a knowledge of the VI. Book of Euclid in the Entrance Examination.

The Committee are aware that in all steps of this kind and extent in education, a difficulty that stands on the threshold is the provision of teachers. For Drawing, the Committee have ascertained from Mr. Locke that teachers can at once be supplied for the colleges; and, therefore, in a few years, it will be easy to supply teachers for the schools, and the teaching of Drawing might commence at an earlier stage of the educational course than is now proposed. In like manner there will be little difficulty in procuring teachers of the rank of Assistant Professors for Botany, Physics, &c., in the course of a year or two, even if not at present. With respect to the school teaching in Experimental Physics, it would be necessary to bring the Head or Second Master of each zillah school to Calcutta for a month or possibly more in the cold weather, when Mr. Woodrow will undertake that they shall be taught to manipulate the apparatus which it is proposed to supply to the zillah schools. These men on their return will exhibit to the schools, and there will then be little further trouble, since none of the Junior Masters who hope to rise to a Head Mastership will omit to qualify as experimental lecturers.

It is, however, hardly to be expected that men entirely unacquainted with the manipulation of apparatus should acquire in all cases the requisite skill in the course of the one or two months' instruction which they would receive in company with many others; and it may, therefore, be advisable, at first, to supplement this instruction by employing trained teachers of science, who should visit the principal schools and instruct both the masters and their classes in the experimental part of the science teaching.

In the minor aided schools, it is possible, nay probable, that in spite of all precaution to render the teaching practical, considerations of economy may operate to prevent the attainment of this object, and endeavours will be made to train the boys up to the Entrance Standard by the sole aid of some cram-book. But the Committee hope and believe that this will never be more than partially the case. Experiments in Magnetism, Electro-magnetism, and similar subjects are known to be most fascinating to the acute Bengalis (young and old), and even a glass pump or siphon attracts the close interest of an uneducated coolie. It will lie with the School Inspectors to see that in the zillah schools the apparatus is kept in workable condition and used for the purpose of instruction; but the inherent attractiveness of Experimental Physics will be the best guarantee that, wherever the means of experiment can be procured, the objects of the Committee will be carried out. It may be possible to arrange in the better zillah schools that a zealous Head Master who proves a good lecturer may exhibit not only to the upper classes of his school, but to the parents and friends, with good results.

With regard to the practicability of this part of the scheme, it may be mentioned that Mr. Woodrow has consulted some of his most experienced Deputy Inspectors, and Mr. Clarke has consulted the Deputy Inspector of Schools in Dacca, and these gentlemen are of decided opinion that what is proposed by the Committee can at once be carried out in the schools.

In preparing this scheme, the Committee have taken care that the subjects are such as can be examined in. As regards Drawing, Mr. Locke has fully satisfied the Committee on this head. With respect to Botany, there may be at first a little trouble in carrying out the practical (that is the most valuable) part of the examination. The Committee believe, however, that though there may be, at first, some little expense incurred in deputing qualified examiners to the more remote centres at which the First Arts Examinations are held, in order to see that proper specimens are supplied to the examinees, yet any such difficulty will speedily diminish and disappear.

The introduction of a number of new subjects into the Arts course will necessitate a considerable modification of the course as at present laid down,—either the removal of certain subjects now compulsory to the category of optional subjects, or else their entire exclusion.

It would be to exceed the legitimate functions of the Committee were they to recommend the exclusion of any subject which is foreign to the class with which they have specially to deal; but they feel that the question is one which they cannot entirely ignore, since the practicability of their own proposals depends upon its being satisfactorily solved. With regard to the Entrance Examination, indeed it appears, from the facts recently laid before the Senate, that some additions may be made to the present course with advantage, since it is stated by those well qualified to speak to the facts that the present course is insufficient to occupy many of the candidates up to the age of admission to the examination. But such is not the case with the course for the First Arts and the Degree Examinations, and it is necessary, therefore, to consider what modifications can be made in these, so as to admit of an increase in the Natural and Physical Science Department of the course.

Assuming, then, that it is not desirable to strike out any of the subjects at present included in the course, there remain two alternatives, either of which allow of the introduction of Physical Science subjects to the extent now proposed. The one is, to make all the subjects (except English) which are now compulsory, as well as the present optional subjects, *optional but not alternative* subjects of examination, bearing marks, of which a certain minimum total would be required for the degree; and, in order to provide against superficiality, to deduct a certain fixed number from the papers on each subject, as is the practice in the examinations for the Indian Civil Service. This would admit of, though it would not compel, a large introduction of Physical Science, and since it would release students from the necessity of passing in some of the present subjects of examination, it would doubtless tend practically to a considerable extension of Natural and Physical Science in the Colleges. The other alternative is to make these sciences compulsory, and to remove one or more of the present obligatory subjects, for instance, Mental and Moral Science, to the optional list. This plan will probably recommend itself to the Senate as being most effectual to the present object, and as involving the least interference with the present system.

The Science course which the Committee have resolved to recommend on the grounds now specified as the most practicable and best adapted to the end in view, is the following :

- A.—For the Entrance Examination, it is proposed to add to the present list of subjects—
 - 1.—The VI. Book of Euclid.
 - 2.—The answers to a schedule of questions (Appendix A.) on a set of boxes of apparatus* by Ladd, Griffin, and other instrument-makers, illustrating Experimental Statics, Hydrostatics, Pneumatics, Heat, Magnetism, and Electro-magnetism.
- B.—The following subjects to be introduced for the First Arts Examination :
 - 1.—Drawing. Stage I. of the Government School of Arts' course, *viz.*, Elementary Linear Drawing,—(a) by aid of instruments (Practical Geometry); (b) free hand outlines of simple rigid forms from the flat, *i. e.*, from copies or flat examples.
 - 2.—Physical Geography of India; and one of the following according to option :
 - 3a.—Botany according to Appendix B.

* A set of these may be seen at the Office of the Director of Public Instruction.

3b.—Elementary Chemistry according to the schedule extracted from the London University Examination for Women in 1869, omitting the section on Heat (Appendix C.)

C.—In the course for the Degree—

- 1.—Drawing, *viz.*, a portion of Stage IV. of the School of Arts' course. (a) Higher Practical Geometry; the use of Scales and other Mathematical Instruments. (b) Projection, Orthographic, Isometric, and Perspective; and the Projection of Shadows.
- 2.—Chemistry and Physics as at present laid down in the list of optional subjects.
- 3.—Zoology, as in Milne Edwards.

A work on the Physical Geography of India will have to be specially prepared, and in the event of the present scheme being adopted, Mr. Blanford will be prepared to undertake it if desired to do so. It will also be necessary to draw up a little book of directions for the use of the apparatus specified in A. This Mr. Woodrow has undertaken to prepare. For the Botanical course, as specified in the schedule appended, Oliver's work on Indian Botany may be used.

In conclusion, the Committee would repeat that the present scheme makes no claim to being a complete, or indeed excellent, scheme for teaching science. They have been well instructed by the Syndicate to provide a scheme for *introducing* science, and they have therefore sought, above all things, to construct one that can be practically worked under existing conditions. As a knowledge of the elements of science becomes infused into the present generation of pupils, and as the popular knowledge of common things, which it is so well fitted to impart, filters down through the teachers and pupils, it will become possible to enlarge and systematise the scheme, and this the Committee look forward to as the not distant result of the measures now proposed.

P. S.—Since the above report was in type, the Committee have learned that a Committee of the London School Board has lately devised a plan for introducing the teaching of science into primary schools, and according to the latest account, their plan has been laid on the table of the Board. In one important particular it is exactly parallel with that proposed in the foregoing report, though more elaborate. It is proposed to have a schedule or syllabus of experiments in Physical Science, which is grounded on the experiments to be shown with the apparatus in ten boxes. A sketch of lectures (or rather an elementary text book) is to be put out by the Committee themselves (or under their sanction), for use in the schools, which shall explain popularly the experiments in these lectures. They further propose to have a highly qualified special lecturer, who shall travel round to each school of his circle in turn, and deliver there a special course.

H. WOODROW.
J. EWART.
C. B. CLARKE.
H. F. BLANFORD.

APPENDIX A.

Schedule of Experimental Science for the Entrance Examination.

In the answers of students to questions set out of this schedule of experimental science, no mathematical calculation will be required. What is wanted is a general description of the experiment, illustrated with a good figure.

STATICS.

The following propositions, which will be proved in the college course, may be assumed at the Entrance Examination:

- (a.)—The parallelogram of forces.
- (b.)—A body supported at a fixed point and acted on by forces in one plane will remain at rest, if the moments of the forces about the point balance one another.

To find by means of a scale and protractor the resultant of forces acting in one plane on a point.

To find the relation of the power to the weight in the following apparatus :

- (1.)—The different kinds of levers and combinations of levers.
- (2.)—The wheel and axle.
- (3.)—The pulley and combinations of pulleys.
- (4.)—The inclined plane.
- (5.)—The screw.

To find the centre of gravity of a flat surface, and to show that the body, if supported at that point, will be at rest in any position.

To show that, when the centre of gravity is as low as possible, a body will be at rest in stable equilibrium.

To apply the above propositions to common things, such as a pair of scales, a false balance, and how to weigh correctly with it, a steel-yard, a *banghi*, a *denke*, a pair of scissors, the weighted pole to draw water from a well, a betel-nut cuttur, the lid of a box, a cart, a sugar-cane mill, an oar, a rudder, a boat sailing with a side wind, upsetting of a cart, the stability of equilibrium of loaded spheres and hemispheres with light figures on them, a crank, children's toys, &c., &c.

HYDROSTATICS.

To define a fluid.

To describe an experiment which shows that the pressure on the base of a vessel containing fluid depends on the height of the fluid, and is independent of its other dimensions.

To describe an experiment with an open glass cylinder and disc to show the upward pressure of water.

To describe and explain the following apparatus and experiments :

- The water level.
- The level.
- The hydrostatic paradox.
- The fountain.
- The hydrometer or lactometer.
- The hydrostatic balance.
- The equilibrium of floating bodies.

Application of the above propositions to explain the floating of a boat in water, swimming, the sinking of bodies in a quicksand, the use of ballast in a boat, the danger of standing up in a small boat, the inflated leather bags used as boats, why a vessel for water appears less heavy in the water than out of it, Hiero's Crown, &c.

PNEUMATICS.

Wind being air in motion as is seen by fans, to deduce inferences about air from the effects of wind.

To show the elasticity of the air by depressing a vessel with its mouth downward in water.

To describe and explain the following apparatus and experiments :

- The bellows.
- The pop-gun.
- The air-pump.
- The Magdeburgh hemispheres.
- The hand-glass.
- The expansion of air in a bladder and of shrivelled fruit under diminished pressure.
- The elasticity of air shown by the bladder lifting a weight, and by the diving-bell.
- The guinea and feather experiment.
- The fountain experiment.
- The bird-cage fountain, or pneumatic inkstand.
- Cartesian figures ascending and descending in water.
- The balloon.
- The barometer.
- The syphon, simple, and when its two legs are equal and are turned up at the end.

The pipette.
 The hookah.
 The syringe.
 The common pump.
 The forcing pump.

To apply the above principles to show the use of a hole in the lid of a kettle or tea-pot, and how flies walk on the ceiling, &c.

HEAT.

To illustrate by simple experiments the action of the chief causes of heat :

- (1.)—The sun, by using a burning glass or mirror.
- (2.)—Mechanical action by hammering a piece of metal, and by rubbing together pieces of wood, &c.
- (3.)—Chemical action, by water on slaked lime, &c.
- (4.)—Electricity, by heating a fine wire with a current of electricity.

To describe simple experiments showing the communication of heat by (1) conduction, (2) convection, (3) radiation,—conduction by the melting of wax on heated metals ; convection by boiling water in a flask and by Faraday's apparatus ; radiation by the reflection and refraction of heat.

To show experimentally the expansion generally of solids, liquids and air by heat,—of solids by the brass gauge ; of liquids by bulbous tubes of water, spirit, turpentine or mercury immersed in warm water, and of air by a bladder being alternately warmed and cooled, or by heating and cooling a bulb tube whose mouth is immersed in water.

To describe the thermometer and how to graduate it. To describe experiments showing that liquefaction and ebullition depend on differences of degrees of heat,—liquefaction by the melting of lead, wax, and butter ; ebullition by boiling water, oil, and spirit.

To state the fact of the latent heat of water and steam, and why evaporation causes a sensation of cold. Ex., water in a porous vessel.

To describe the action—

- (1.)—of the fan or punkah ;
- (2.)—of the kuskus tattie or thermantidote.

To show the elasticity of steam by its forcing the cork out of a bottle.

To explain the principle of the steam-engine by a bulb tube with a piston in it. (Wollaston's instrument).

To shew the principles of ventilation by burning a taper in a bottle with a card down the neck, or with a stopper having two tubes through it.

To apply the above principles to explain the use of a cloth to lift hot things ; of a blanket to keep the body warm, and ice cold ; why axles of carriages become heated ; how heat is used in putting on the tire of a wheel ; why a fire-balloon ascends, &c.

MAGNETISM.

To show the position taken by a light bar magnet suspended freely by its centre of gravity.

The mutual action of two bar magnets.

The magnets formed by the breakage of a magnet made of a knitting needle.

The compass.

The dip compass.

To give a general explanation why the compass points in a northward and southward direction.

The change caused by a magnet on pieces of soft iron,—example, a magnet with soft iron nails, &c.

If a magnet be covered with a sheet of thin paper, and iron filings be sifted over the sheet, they arrange themselves in curves. To show the cause of this, and what the curves indicate with reference to the free magnetic force in different parts of the bar.

To make magnets, and to reverse their poles.

Application of the above to magnetic toys, such as, ducks in water, spinning teetotums, &c.

VOLTAIC ELECTRICITY.

To describe the simplest form of a galvanic battery, consisting of one plate of zinc and one plate of copper or platina immersed in acidulated water.

To show what is the course of the electric current in the water ; what determines its direction ; what is the use of the acid ; why the zinc plate is usually covered with a thin film of

mercury ; why this simple form of battery soon ceases to act properly ? To state some improvements by which the action of the cell is rendered more constant than in its simplest form.

To describe some of the effects of a powerful battery in producing light, heat, nervous action, and chemical decomposition.

ELECTRO-MAGNETISM.

To describe Oersted's discovery that a magnetic needle tends to set itself at right angles to a current of electricity.

To explain the construction of a common galvanometer.

The astatic needle, and what is its use in a galvanometer.

To explain the action of the needle telegraph, and how messages can be sent by it.

If a current travel along a wire bent in the form of helix, to show what is the effect on a bar of soft iron within the helix.

To describe the formation of an electro-magnet.

To describe Richie's apparatus.

To show the simplest form in which an electro-magnet is used in the recording telegraph, or in the sound telegraph.

To describe De La Rive's floating battery, and its action (1) when a thin bar magnet is brought near it, and (2) when another floating battery is brought near the first.

To describe some apparatus for showing the fact of induced currents.

What is the direction of the secondary current as contact in the wire of the primary current is broken and renewed ?

To describe an instrument for quickly breaking and renewing the current in the primary wire.

To describe the construction of the electro-magnetic coil machine, and by what arrangements a weak or a powerful shock can be given.

APPENDIX B.

Schedule of Botany for the First Arts Examination.

- (1).—General characters and functions of Root, Stem, Leaf, Stamen, Pistil, Fruit, Seed.
- (2).—Fertilisation of Phænogams, Germination, Propagation by division.
- (3).—Phyllotaxis, Metamorphosis, Vernalion, Estivation, Stipulation, Placentation.
- (4).—Classification of plants into Phænogams and Cryptogams—Cellular and Vascular—Acotyledons, Monocotyledons, and Dicotyledons—Endogens and Exogens.

(5).—Distinctive characters of the following Natural Orders :

Nymphæaceæ.	Acanthaceæ.	Palmae.
Capparideæ.	Scrophulariaceæ.	Cyperaceæ.
Malvaceæ.	Amarantaceæ.	Gramina.
Leguminosæ.	Polygonaceæ.	Filices.
Cucurbitaceæ.	Euphorbiaceæ.	Fungi.
Compositæ.	Orchideæ.	
Gentianaceæ.	Aroidæ.	

(6).—Conspicuous flowers of three or four different species will be given each candidate at examination. For each of these he will have to fill up the subjoined schedule :

Organ.	No.	Cohesion.	Adhesion.
Calyx (Sepals)			
Corolla (Petals)			
Stamens			
Pistal (Carpels)			

N. B.—Question 6 will carry half the marks of the whole paper.

APPENDIX C.*Schedule of subjects in Chemistry for the First Arts Examination.*

CHEMISTRY of the following non-metallic elements Oxygen : Hydrogen, Carbon, Nitrogen, Chlorine, Sulphur, Phosphorus, Silicon, including their compounds as enumerated below, their chief physical and chemical characters, and their characteristic tests.

Combining proportions by weight and volume. General nature of acids, bases and salts symbols and nomenclature.

The atmosphere,—its constitution ; effects of animal and vegetable life upon its composition. Combustion,—structure and properties of ordinary fuel.

Water—chemical peculiarities of natural waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid, Carbonic Oxide ; Sulphuric, Hydrochloric and Nitric Acids ; Ammonia ; Sulphuretted Hydrogen ; Silica.

OPINIONS OF EDUCATIONAL OFFICERS AND OTHER GENTLEMEN ON THE PROPOSALS CONTAINED IN THE COMMITTEE'S REPORT.

MEMORANDUM.

IN presuming to offer any opinion to the Syndicate on the scheme proposed by the Committee, I must premise that my experience of Indian education has been very short, and also that my pupils are entirely composed of Eurasians and English, who, I imagine, form but a small proportion of those whose education the present scheme is intended to affect.

The opinion I have formed from my experience hitherto is, that the Calcutta Entrance Examination is insufficient to occupy a boy of ordinary abilities, granting that he enters the school early, and that his education be uninterrupted up to the age of 16 years—the lowest age at which boys are allowed to become candidates. It must be remembered, however, that my pupils understand English, and so must have a certain advantage over the boys of zillah schools ; on the other hand, their greater liability to sickness, as compared with Natives, must be set against this advantage.

I consider then that it would be an advantage to introduce another subject into the schools, and the obvious subject to introduce would be Natural Science. This subject has been introduced into English schools for some years past with increasing success, and is a subject which I should think was peculiarly suitable to boys of this country.

I fully concur with the Committee in recommending strongly the teaching of Natural Science in the schools should be of a practical character, and I am pretty sure that it would be impossible to teach these boys the theoretical parts with any chance of success. In the first place such a course would imply a very sudden rise in the mathematical standard required at present in the Entrance Examination, and would also multiply the difficulties of teaching the subject by means of the present masters, which, I think, is a desirable object. Again, the fresh mathematical difficulties would tend to dishearten the boys and take away the interest they would otherwise feel for a subject new and entirely different to their ordinary routine of work. Lastly, the faculty of cram would be promoted by such a course at the expense of that of observation and intelligence : this latter faculty, I may remark is generally very defective in the boys whom I have met with. The great difficulty I find in teaching them is to induce them to use their understanding rather than an unintelligent memory which most of them appear to have, and I consider that a series of experimental proofs, such as that suggested by the Committee, would tend to stimulate their faculties of observation.

On this account, moreover, I think that the course should be made a compulsory subject for the candidates at the Entrance Examination ; in fact, that the introduction of it may be attended with complete success I think that it must be made so. If some other optional or alternative subject be proposed, the difficulties of teaching Natural Science will be increased both by the additional labor to the masters of having two or more subjects to teach instead of one, and also by the depreciated importance of the subject in the eyes of the boys. A new subject of this kind excites curiosity and interest for a time, but

with the generality of boys this soon passes away, unless maintained by adventitious aids. I believe that it would soon die a natural death, unless strongly supported on its introduction, and I think that the necessary support can only be given by making it a necessary subject of the chief examination open to the school. I am sure that the want of success which at first attended the introduction of Physical Science into English schools and colleges, was mainly owing to the fact that the study of it was not compulsory, and so it came to be looked down upon as inferior in importance to the regular routine subjects. At the same time I think it open to question whether these subjects should continue to be compulsory for those who have entered the University. I think we may say that in each individual case the subject of Physical Science will have had a fair trial, if it be made compulsory for the Entrance Examination. A youth in passing the Entrance, we may conclude, has made up his mind whether he has any taste for these subjects or the contrary. Should he have a distaste for them, and I can quite imagine many such cases, or, if he thought other subjects better suited to the line of life he intended to take, would it not be a pity that he should be compelled to sacrifice other useful and important subjects to one for which he had a distaste, and the distaste for which would increase with the increased difficulty of the subject in its new phase. I consider then that the study of Natural Science should be compulsory up to the time of entering the University, and that it should then become optional. There is but little doubt that, if the subject were well handled and made really interesting to the boys, a large proportion would elect to continue the study of it on entering the University, and this surely is all that the Syndicate would desire.

As to the provision of teachers of Natural Science, I think it very desirable, as I remarked above that one or other of the regular masters should take a considerable part of the teaching of the subject into his own hands. It is very difficult for a person who comes to the school occasionally to teach some special subject, to command the attention of the boys, as much as a person who is daily with them, who knows their characters, and is also well known by them. There may be no lack of attention on the part of the boys, or of zeal on the part of the teacher, yet still he will find to reach the understanding of the boys as a person does who is in the daily habit of studying their several capacities, and who knows the difficulties which would be likely to present themselves to each boy. But granting that if the regular masters instruct the boys regularly in Physical Science, I think it very desirable that his instruction should be supplemented by that of some highly qualified lecturer at certain intervals who may overlook the teaching of the ordinary master and may also give lectures, at which the master as well as the boys should attend. I believe that a conscientious master with some trouble might qualify himself to give adequate lectures, and these, if supplemented by the lectures of a high class travelling lecturer, would be more efficacious than those delivered by an inferior lecturer in Physical Science and by *him only* at more frequent intervals. My experience in England has shown me that lectures given even by men of high capacity who merely visit the school for a particular lecture once or twice a week are useless to the greater number of the boys, unless supplemented by the supervision or instruction of some regular master. I think, therefore, that, according to the plan mentioned, the instruction of the boys might be brought to great perfection; at first, no doubt, there would be failures; but as time went on, these would diminish and the masters might become excellent teachers; for, as every one knows, the best method of perfecting ones own knowledge in any subject is to teach it to others.

Lastly, I consider that the introduction of Drawing into schools is very desirable. In a country like this, where there is a wide field for engineering and surveying, Drawing should be an important subject in every school. It is astonishing how quickly young and often stupid children pick up with facility the power of Drawing objects placed before them. Beginning with wooden blocks of the simplest description, they soon are able to draw a chair or other difficult piece of furniture in any position. Thence they soon proceed to sketch houses and other objects out of doors; and this in a comparatively short time, after receiving an hour's lesson once or twice a week. Geometrical Drawing of course requires a greater amount of intelligence, but I think

it might be introduced with advantage into the higher classes. As to the provision of teachers, I should have thought that were Drawing introduced as one of the school subjects, ample employment might be found for one or more Drawing Masters, in a large station like Allahabad for instance, who might attend in turn at the several schools.

G. H. D. WALKER,

Head Master, Allahabad High School.

MEMORANDUM.

THE Syndicate, in appointing a Committee "to report on the best mode of introducing the study of natural and physical science into schools and colleges in India," has, I suppose, predetermined that those sciences shall in one shape or other form a part of the University Course. It would, therefore, be out of place for me to discuss, except incidentally, the question whether any such addition to the present list of subjects is likely to be attended with useful results. And as the Committee pointedly declares that the scheme which they have suggested "makes no claim to being a complete, or, indeed, excellent, scheme for teaching science," nothing would be gained by criticisms in detail, even if I thought myself competent to offer them. The one point left is the practicability of the proposals set out in the report.

That the scheme runs a risk of proving not only useless but positively injurious, is clearly recognized by the Committee, who hold that the difficulties likely to beset it "must be met and overcome at whatever cost of exertion and pecuniary outlay, if the teaching of physics is to fulfil its main objects, and not to degenerate into a mere art of reproducing words and phrases which in the learner's mind are not clearly associated with their appropriate external objects."

I cannot, however, help thinking that the measure of those difficulties has been vastly under-estimated. They will be very great, whether we regard the capacities of the student, the attainments of the large majority of school-masters, or the expenditure necessarily involved.

As to the first of these points, it is of course very possible that the intellectual atmosphere of Bengal differs widely from that of the North-West. Indeed, the difference must be much greater than I could have supposed, if, as is stated "by those well qualified to speak to the facts, the present Entrance Course is insufficient to occupy many of the candidates up to the age of admission to the examination." Instances of such scholastic voracity have certainly never come within my notice, even among the greatest gluttons at work. On the contrary, I believe that, even under the regimen now prescribed, the student's mental digestion is in danger of being impaired, since the classical languages have been inserted in the First Arts Course; the strain has become so much more intense that, however great the candidate's success in the Matriculation Examination, he suffers in the end from having attempted more than he could do thoroughly well. It matters little whether the candidate takes up these languages at the Entrance Examination, as in a few years he will be obliged to do, or postpones the hour of his trial till the First Arts. In the latter case he feels clearly enough that if he is to go beyond the Entrance Examination, he must begin his classical course while there is yet time, and his college authorities with sympathetic forethought aid his resolution by rendering those studies compulsory. The result is a corresponding neglect of English, the most important and most difficult branch of his studies, and I am persuaded that students will find it almost impossible in the latter years of their course to acquire that facility of expression and that quick grasp of the thoughts of others which ought to belong to all who aim at the higher degrees conferred by the University.

The Committee does not contemplate, nor would I recommend, the removal of any subject from the Entrance Course. If, then, a fifth subject be added, the number of failures will be largely multiplied, or success will be more valueless than it is even at present. The teaching of physical science cannot,

therefore, in my opinion, be safely introduced at all events earlier than in the First Arts Examination. Even then I should doubt the wisdom of the present plan, and of the two alternatives offered, should certainly not prefer that towards which the Committee leans. As regards the B. A. Degree, I have on other occasions advocated the principle of selection, certain classes of studies being grouped together. In this last examination a course of physical science, of a more complete and thorough character, might, perhaps, other obstacles being removed, have its place with advantage.

Before going on to consider the material difficulties which lie in the way of the present scheme, and which I look upon as in themselves sufficient to forbid our entertaining it, I would remark that the Committee seems to me somewhat large in faith if it supposes that the interesting nature of the study will deter from a reliance upon cram books. Experimental physics are, no doubt, attractive to most minds and at most periods of life. But the attractiveness to young students would, as a rule, be similar in kind to, and not vastly different in permanence from, that felt by the Committee's "uneducated coolie" when exposed to the seductive charms of a glass pump or syphon. I have seen Natives of these parts intensely interested by a lecture on experimental Physics, just as I have seen them intensely interested by the tricks of a clever juggler. The thing is, in fact, regarded as a species of *hiqmat*, novel and curious; and I greatly doubt whether the examination minimum of knowledge being attained, there would be found in the happy possessor of it a residuum of interest productive of results in after-life. With most Native students (I speak as a Mufasalite) the disposition is to look upon all subjects as equally interesting and equally uninteresting. This disposition we, perhaps, foster by giving them no option as to the line of reading they will take up. But I believe that if, in the examinations below the B. A., any choice were permitted, it is not the inherent interest, or the inherent importance, of one subject as compared with another, but the expenditure of time and thought which each relatively demanded that would turn the scale in this direction or in that. A First Arts student hardly knows what is, and what is not, congenial to his mind; and even if it happened that his bent was towards Natural Science, the cases would be rare in which his educational course being run, it would be possible for him to follow out a study so expensive in its more interesting branch. And while it will be so seldom that he would be able to indulge his taste for experimental science, it does not seem to me that his theoretical knowledge would be such as to justify us in abandoning any of the subjects at present laid down in the course.

The student's interest, or want of interest, in the suggested branch of study is, however, of secondary importance towards deciding the present questions. There are two considerations which, to my mind, render it impossible that this or any other scheme of Physical Science should be introduced into Zillah Schools, and, as a consequence, render it impossible that the study should find a place in an examination lower than the First Arts.

In the first place the expense will be simply enormous. Unless the whole thing is to degenerate in the way the Committee itself apprehends, each school must be supplied with a variety of apparatus, the original purchase of which would constitute a very formidable item in any educational budget, and which, in the hands of men little better than amateurs, will need frequent renewal. I should very much doubt whether the government of any Province would be disposed to dip deep into its purse in aid of a scheme the success of which is, to say the least, very questionable. And at a time when all expenditure upon English education is so rigidly scrutinized, and in many quarters so strongly opposed, it seems hardly wise to talk of overcoming difficulties "at whatever cost of pecuniary outlay." But if the Government, with the vast resources at its disposal, should not shrink from the burden it is proposed to lay upon it, what will be the case with the aided and independent schools? To make Physical Science one of the obligatory subjects of the Entrance Examination, would, I believe, be to strike off the Entrance Class in every one of these schools. Even at present they find it no easy task to pay masters competent to the work required of them. With Physical Science added, not only would

the cost of apparatus in itself be almost equivalent to a prohibitory duty upon the higher education, but it would become necessary to increase those salaries to provide which already taxes the proprietary bodies to the utmost.

Again, the Committee seems to me to have a very exaggerated idea of the capacities of teachers in all schools, whether maintained or aided by Government. Leaving for the present the question of experimental dexterity, what do nine-tenths of the masters in District Schools know of Physical and Natural Science? I believe they know absolutely nothing. Of course we might in time get men who, having themselves been trained, would be capable of training others; but as the new accomplishment will hardly be one within the attainment of the majority of men now employed, we shall at all events have to wait a considerable time before any instruction of a really useful nature can be imparted. Compel the class of masters we now have to teach Physical Science, and what they will do will be to keep a few lessons ahead of their pupils, with results which it is unnecessary to point out.

As to the experimental branch of the Science, the Committee's proposal is to compel masters of schools to attend a six-weeks course of lectures in Calcutta, during which they are to be taught to manipulate the apparatus it is intended to supply to Zillah Schools. I was always under the impression that skilful manipulation in experimental science was an accomplishment which required long and patient industry, and that even those who had given years, instead of months, to the study would acknowledge to a very mortifying percentage of failures. I may be underrating the receptive powers of the gentlemen who are to be the subjects of this experiment, but I cannot convince myself that they will return to their novel duties the adepts the Committee so hopefully pictures to itself; and I am sure there are some of us who will rejoice that a Zillah School-mastership was not woven into their web of life. The Committee, it is true, so far gives way to fear as to think it possible that men entirely unacquainted with the manipulation of apparatus will not in all cases acquire, during their brief period of instruction received in company with many others, that finished dexterity which will be necessary if they are to hand on the torch to others. It is, therefore, proposed to supplement the instruction given in Calcutta by employing itinerant *maîtres d'armes* to perfect the more backward of these holders of, or aspirants to, Head Master-ships in Zillah Schools. In all this the Committee displays a hopefulness of which those of us whose are laid in the less pleasant regions of the North-West, will scarcely venture to declare themselves partaken, while the manner in which expense is disregarded is almost as marked here as in other parts of the scheme.

The Committee's belief in the practicability of their plan, so far as it affects minor aided schools, seems to rest mainly on the well-assured convictions of "experienced Deputy Inspectors." That class of officers in the North-West is not in point of confidence a whit behind their brethren in Bengal. "If it is possible, it is done; if it is impossible, it will be done," is a sentence which would roll glibly enough off the tongue of most subordinates called upon to decide as to the practicability of some pet project of their superiors; but the *ho jaega* thus obtained is seldom considered as a very solid foundation on which to build great hopes.

On the whole my opinion is, that the present scheme is impossible as regards Zillah Schools and the Entrance Examination; that it would be unwise to introduce it in colleges for the First Arts Course; and that if Physical Science is to become an alternative in the higher degrees, it should be studied more completely than will be possible, unless Professors are specially appointed for the purpose, and funds larger than we can expect of Government are placed at our disposal for the purchase of apparatus and materials with which to experiment.

K. DEIGHTON,
Principal, Agra College.

No. 273, dated the 12th August 1871.

From R. HAND, Esq., Principal, Berhampore College, to the Registrar of the Calcutta University.

I HAVE the honor to acknowledge your memorandum of the 9th current, forwarding the report of a Committee appointed to consider the best mode of introducing the study of Natural and Physical Science into schools and colleges, and requesting a full expression of my opinion on the scheme suggested by this Committee.

The Committee say that in their scheme they have endeavoured to fulfil two fundamental conditions,—*viz.*, that its execution shall be “practicable,” and its teaching of “a practical character.”

Practical teaching, or the illustration of theory by diagrams, models and experiments, is, indeed, as the Committee declare, essential to its usefulness; and this I hold to be especially true in the case of Bengalis, who of all people I know are the least inquisitive, and the most disposed to content themselves with words. But this practical teaching must supplement theoretical teaching by means of text-books, and not be confined to *vivâ voce* explanations of apparatus. A book of directions for their use may be all well enough as a help to the teacher; but the student needs, and, if he is to be effectively taught, he must have what the Committee of the London School Board, it is said, have in preparation an elementary text-book to fall back upon for reviving the lessons practically taught in the class room. Before, then, the present scheme, or anything like it, is put into practice, this desideratum must be supplied.

To pass on to the practicability of the scheme, I must demur to the proposal of practical examinations in such subjects as, in my opinion, utterly impracticable, in connection I mean with the regular University Examinations. To render such *vivâ voce* examinations other than a mere farce, limit the test to the uttermost, you cannot give less than a quarter of an hour to each candidate, for manipulating requires time and patience. At this station I usually have about 120 candidates for the Entrance and First Arts Examination, to test whom in this practical way would require at least 30 hours, or five examination days, if *one* “qualified examiner” is deputed for the work, and it will be necessary to depute five such examiners if the examination is not to extend, as in fairness to the candidates it should not, beyond one day. The expense of such a measure would not be a “little;” and, whatever it might be, to me it appears an unnecessary expenditure of money, for efficiency of the practical instruction might well be left to departmental tests, and the examinations of University confined to paper exercises.

I come now to the details of the Committee’s scheme. To me it certainly appears that it is proposed to take far too wide a range of subjects for the Entrance Examination. The course cannot be so comprehensive if the instruction is to be real. True the instruction is to be of a popular character and elementary, but it surely is not designed to be superficial; for no lasting good—no good, indeed, whatever—can come of such teaching. The object wherewith physical science is to be introduced into our schools and colleges is, as the Committee express it, “to train the powers of observations;” but it needs time to develop and much more to *train* these powers, and to “thrid every science,” as the Committee’s scheme, if adopted in its integrity, would necessitate, is quite useless to this object. I take the liberty, therefore, to suggest that, *with the modifications* in the Entrance and First Arts Examinations to be hereafter stated, the course for the former shall include the first four subjects only of Appendix A., and for the latter the remaining three subjects of the appendix, together with Physical Geography and Drawing as recommended by the Committee; and either Chemistry as in Appendix C., or so much of Astronomy as is contained in Schædlers Book of Nature, or Lockyer’s Elementary Lessons in Astronomy, Chapters 1 to 4. Botany, I think, would better come in with the course for the B. A. Degree.

Besides Astronomy, there is one very important branch of physical science which, in my opinion, ought not to be omitted from our syllabus of studies,—I mean Human Physiology;—and I take the liberty to recommend that

Huxley's Elementary Lesson in Physiology form part of the English course for the Entrance and First Arts Examinations,—the first four chapters for the former and the rest for the latter. I am aware that there is a rule which restricts examination in languages to the meaning of the text, and prohibits questions on its matter or subject; but this rule serves no useful purpose, is unnecessary, and might well be repealed.

The practical teaching of this subject can be effected by means of Johnstone's plates, and besides, its direct personal interest to every student will insure attention to it, quite as much as models and experiments can to other branches.

In representing *the modifications* I propose in the existing Entrance and First Arts Standards of Examinations, I would, in the first place, observe that, to what extent soever it may be *exceptionally true* of the "many candidates" referred to by the parties whom the Committee represent as "well qualified to speak to the facts," with *the great bulk* of entrance candidates the present Entrance Course, under the pass standard assumed, far from being insufficient to occupy them, is more than can be easily or thoroughly learnt up to the age of 16, *i. e.*, in eight years; for, in general, English teaching does not begin before the age of eight years, and often not until the tenth year of age.

The crying evil of the present system of teaching which depends upon the University Examinations is the pernicious cramming that is resorted to for getting up youths to the assigned standards, and to increase this evil by superadding to the course would be destructive of all healthy mental development, even though as in physical science the added subjects directly tend to develop the mind.

In this conviction I hold it to be my duty to protest against the addition of the 6th Book of Euclid to the Entrance Course. The Committee would introduce it as a preparation for practical geometry in connection with drawing, but not to observe that there is no necessary connection between practical drawing as of figures, projections, and outlines, and a knowledge of the VI. Book of Euclid, it is enough to say that the Committee's scheme assigns drawing and practical geometry to the First Arts and not to the Entrance Examination. Instead of such an advance in the Mathematical Course, I would propose that *the former minimum pass standard* of 25 per cent. be restored; for, with the present standard, the time and attention required for mathematics renders it extremely difficult, if not impossible, to give adequate attention to other subjects and especially to English.

I would further submit, for the consideration of the Syndicate, the advisability of making Sanscrit optional for all the Arts Examinations. Until this is done, the permission to take Bengali as the 2nd language for Entrance into the University, is simply nugatory; for, as long as Sanscrit shall be compulsory and the course in Sanscrit as high as it now is, no one desirous of reading beyond the Entrance Standard can avoid taking Sanscrit for this examination, hence this language must continue to be taught in our schools—a subject the difficulty of which seriously interferes with other studies.

It appears to me that Collier's little book on English History might also be well dispensed with, and the course in history restricted to Marshman's India, Volume I.

I would here submit for the Syndicate's consideration the advisability of restoring the study of English composition by introducing it into the Entrance and First Arts Examinations. It is notorious that our graduates are far behind the students of olden times in their knowledge of English, and especially in their ability to write correctly. One cause of this is, that they are not early exercised in composition. Edward's Composition might well form part of the Entrance and Graham's of the First Arts Course.

In the First Arts Course I propose to substitute for the present text book in History—the most unsuitable one for Bengalis that I have ever seen—the former work, *viz.*, the Students' Version of Hume's History of England. I would also remove Logic and Mental Philosophy from the course, to allow of greater attention being given to other subjects more important to our students.

To the proposal to use a "set of boxes of apparatus" to illustrate, that is, practically to teach Physical Science, I see no other objection than the extreme likelihood of the apparatus being constantly injured, and the difficulty, which in the Mofussil amounts to the impracticability, of their being repaired. Instruction, therefore, ought not to be made *to depend entirely* on them.

As the Committee have entered upon the subject of Teachers and Professors of Physical Science, I take the liberty to repeat here a suggestion made to the Director of Public Instruction in my Annual Report of 1865-66, dated the 1st May 1866. I wrote then as follows: "I would also suggest that early arrangements be made for the study of the Physical Sciences. There is no question of the advantages that will accrue from such studies; and as Native students really affect them, every facility should, in prudence, be given for their prosecution. Were the Medical Officer of a Mofussil College also Lecturer on these sciences on a consolidated salary, say of Rupees 300 a month, the arrangement would, I submit, secure efficiency with economy. The opening for private practice as a doctor, which such an officer would have, would attract able men and render the appointment desirable." In submitting this suggestion to the Syndicate, I would modify the remuneration to Rupees 200 a month, which, with private practice, will, I believe, attract good men,—Graduates or Licenciates in Medicine of the Calcutta University, who have a speciality in such sciences.

MEMORANDUM.

As an earnest advocate for the eventual introduction of the study of the Natural and Physical Sciences into the Calcutta University Course, I am very glad to have an opportunity offered me of expressing an opinion on the scheme which has been proposed for effecting this purpose by the Committee of the Senate. In venturing to criticise unfavourably a plan elaborated by the distinguished men of science who compose that Committee, I write with the utmost diffidence; but I am deeply impressed with the conviction that the scheme, if adopted by the University in its present form, would seriously injure the prospects of science in this country.

The points to which I wish particularly to advert are, *first*, the proposal to add to the extent, and, therefore, to diminish the depth and solidity of the Entrance Course, already, in my humble opinion, too extensive; *secondly*, the startling innovation of introducing Drawing into an Arts Course; *thirdly*, the absence of any sufficiently exact and definite statement of the method by which an adequate scientific training is to be brought within the reach of the students preparing for Matriculation. On the general question of the comparative advantages of the study of the Natural and Physical Sciences and of the studies already provided for by the University, nothing further, I imagine, need be said than has already been said in the course of the discussion which has resulted in the appointment of the present Committee; moreover, I have no doubt that my views would exactly coincide with those of the Committee on this point.

First, with regard to the proposed extension of the Entrance Course, I am strongly of opinion that the University should aim at a greater concentration of the energies of its students on a few subjects, rather than encourage any further diffusion of their work. My belief is based upon experience derived partly from having conducted various test examinations in schools, partly from observation of the average acquirements of University Freshmen as displayed in college lectures; and I venture to think that that belief is fully supported (1) by the statistics of recent Entrance Examinations, (2) by the commonly received opinions current amongst those who take an interest in

With regard to the Entrance Examination, indeed, it appears from the facts recently laid before the Senate that some additions may be made to the present course with advantage.—*Report*, p. 6.

educational matters in Bengal. Notwithstanding the assurance of the Committee noted in the margin, I cannot help stating most emphatically my firm conviction that, if we can rebut at all the charge of encouraging superficiality and smattering at the cost of sound and accurate scholarship, we can only do so with great difficulty. *Multa, non multum* seems already to be too much the motto of our University system; and I dread to think of what would be the effect, on the

intellects of our Freshmen, of a far less formidable addition to the Entrance Course than that which is involved in the imposition of the VI. Book of Euclid, and even the most elementary propositions in "Experimental Statics, Hydrostatics, Pneumatics, Heat, Magnetism, and Electro-magnetism." The VI. Book of Euclid (though undoubtedly an admirable preparation for the scientific study of Practical Geometry) appears to be a very gratuitous addition to the course proposed by the Committee, for the chief recommendation of this course seems to lie in its supposed *practical* nature rather than in any scientific or logical arrangement of studies. Rather than *add* a new and difficult Book of Euclid, I would prefer to see the IV. or even the III. and IV. *withdrawn* from the course, with a demand for increased accuracy and facility in working riders upon the propositions of the books retained. When it is remembered that, of the candidates who appear for matriculation, about half are regularly plucked every year, when it is remembered that, on an average taken from the results of the last five years, *no less than 93 per cent. fail to obtain half marks*, I confess I cannot understand how it is possible to imagine that the subjects of the Entrance Examination are not already at least sufficiently numerous.

I have referred to a commonly received opinion that cramming and smattering are encouraged by the Calcutta University. I believe that no one who is in the habit of reading the Indian newspapers, or of hearing educational topics discussed in general society, can doubt that some such opinion is very commonly held amongst educated Englishmen in Bengal. I firmly believe that this opinion is very largely based upon sheer ignorance of what really have been the results effected by our higher educational system. It is also, doubtless, often owing to mistaken notions of what can or ought to be the nature of those results. But it is at least probable that there is a substratum of reason for such general unanimity of opinion, and I cannot but think that the University, since its usefulness largely depends upon the estimation in which its certificates are held by the public, should avoid with the utmost care any measures the adoption of which might tend in any way to confirm the unfavorable impression to which I have alluded.

Secondly, with regard to the proposed introduction of drawing as a compulsory portion of the Arts Course, I am at a loss to know what considerations can have influenced the Committee in deciding to make it a part of their scheme, which would not apply with equal force to music, or shorthand writing, or swimming, or shooting, or riding, or a hundred other Arts, whose useful or æsthetic properties commend them. I imagine that drawing is no more a branch of Natural and Physical Science than any one of the Arts which I have named. It is doubtless a matter for regret that Bengali students are often unable to "see that a circle projects into an ellipse, or that when a rectangular box is drawn in perspective, all the angles at one corner of it are not projected into right angles;" but I really find it difficult to believe that the evil results of this obliquity of mental vision are so serious as to make it worth while to impose on the whole body of our undergraduates the laborious study of a semi-mechanical art, which will probably be highly distasteful to a large number. I do not suppose that the Committee really lay much stress on the point that a knowledge of drawing will enable a student more readily to comprehend a few of the figures he will meet with in his mathematical studies, and even if this be insisted on, a chapter on the use of the simple mathematical instruments might be added without much difficulty to the Mathematical Course.

Drawing, it appears to me, may be considered either as one of the Fine Arts, or as a mechanical art of the lowest and most servile character, according to the spirit in which it is taken up. If we consider drawing as one of the Fine Arts, I think it will be allowed that the draughtsman in this sense must be, like the poet, born not made. No amount of school-of-art teaching can create genius; nor, even if it were possible, do I think that the development of artistic genius can ever be rightly held to be one of the functions of a University. If, on the other hand, we consider drawing as a mere mechanical art, it appears to me that its introduction into our course, so far from being useful, would be positively injurious; and this apart from the consideration that

it would be a burdensome addition to a course already sufficiently laborious. The Committee rightly say that "one of the principal objects of the scheme is to ensure the cultivation of the observing faculty;" but when they add, "as regards the observation of form and proportion, no subject of instruction appears so well fitted for the purpose as the practice of elementary drawing in outline," they appear to me to attach a very ignoble meaning to the term "observing faculty." I take it that the observing faculty which we should cultivate is not the merely mechanical observation of form and proportion, which is simply the cultivation of what is popularly styled "a straight eye," and is as well taught by carpentry or smiths' work as it is by elementary drawing, but rather the observation of the facts and phenomena of the material world around us, and especially a philosophical appreciation of the relations between these phenomena and their causes and effects. "Of what shape is it?" seems to me to be a question of very minor importance; we should rather teach our students to answer the questions. "From what and how is it produced?" "What are its effects and their uses?" No one who has observed the work of Bengali tailors, carpenters, or moulders, can doubt that the Bengali mind (even amongst the lowest classes of skilled laborers) has the faculty of mechanical imitation largely developed: I venture to think that any attempt to foster the faculty amongst the educated youth of the country would be both unwise in itself, and unworthy of the University.

On the *third* point, the absence of any sufficiently exact and definite statement of the method by which an adequate scientific training is to be brought within the reach of students preparing for Matriculation, I am unwilling to say much, as the Committee seem to be very confident about the practicability of this part of their scheme. There will doubtless be no difficulty about supplying the great Government colleges with teachers of the rank of Assistant Professors for Botany, Physics, &c., and so the tuition of the bulk of our *undergraduates* can be well provided for. But with regard to the schools, and especially the minor aided school, I fear it will be far otherwise. I confess I am not very sanguine about the brilliant results that may be effected by bringing up the Head Masters to Calcutta to be trained in the Natural and Physical Sciences "for a month or possibly more in the cold weather;" nor do I think that the flying visit to the various schools of an itinerant lecturer would do much towards dispelling that confusion in the minds of the unfortunate Head Masters which (I cannot but think) would be the chief result effected by the month's high-pressure cramming in Calcutta. Moreover, even if the plan were in itself a satisfactory one, since the schools that feed our University are scattered over an immense space,—from Burma to the Punjáb, and from the Himalayas to Ceylon,—the expense of bringing up the Masters and sending them down again would be very heavy, the number of itinerant lecturers would also be necessarily large, and the time occupied in their peregrinations very considerable. Again, a similar cause—the wide dispersion of our examining centres—would, I fear, be found to present more difficulties in carrying out the practical part of the examination than the Members of the Committee appear to contemplate, especially in the matter of providing vast numbers of botanical specimens, identical in species and in general appearance, on the same day in climates ranging from the cold of the hills to the various degrees of heat of the Punjáb, the North-West, the Central Provinces, Oudh, the Lower Provinces, Burma, and Ceylon.

I venture to believe that ultimately a solution of all these difficulties may be found in some scheme for introducing, gradually and carefully, the Natural and Physical Sciences into our higher examinations. But whenever such a scheme may be adopted by the University, I earnestly hope that it will not attempt either the enforced extension of a curriculum already too extensive, or the recognition of a subject foreign to the scope of the most comprehensive University Course.

E. LETHBRIDGE, *M. A.*,

Late Scholar of Exeter College, Oxford;

Professor of English Literature & History

in the Hooghly College.

MEMORANDUM.

I AM called upon to give a full expression of my opinion, in reference to a scheme that has been framed for the purpose of introducing Natural and Physical Science into the course of instruction pursued in our schools and colleges.

As to the pleasure and advantage to be derived, by old and young, from a knowledge of these sciences, and the importance of an early induction into them, there can be no question; but as to what extent and in what form they can best be introduced, and what place they should be allowed to hold in regard to other and more general subjects, there is room for difference of opinion. The scheme proposed lays no claim to being final, nor absolutely the best, but simply the one that appears the most suitable for the purpose intended under existing circumstances.

The Committee who framed it are fully alive to the fact of its being of the first importance that it should be *practicable*. They tell us at the very outset that they have endeavoured to fulfil this important condition. But before we can decide upon the practicability of a scheme of this nature, it is requisite to know under what form it is intended to carry it into execution in the face of existing conditions. In answer to this, we are told that they have endeavoured to secure that the teaching contemplated by the scheme shall be purely of a *practical* character. They are aware that great difficulties lie in the way of the fulfilment of this condition; but these difficulties, they say, must be met and overcome at whatever cost of exertion and of pecuniary outlay. Without entering into any discussion as to the relative merits of the experimental and the theoretical modes of teaching, I will merely say that I cannot concur with the Committee in the absolute and exclusive preference they evince to the former of these modes. They say, by way of accounting for the fragmentary and unsymmetrical character of their scheme, that they have "deemed it of more importance to bring the objective character of the sciences *home* to the mind, than to adhere to a logical sequence of subjects." I cannot help looking upon this as a retrograde step contrary both to the dictates of reason, and the matured judgment of the best authorities, as to what should be the grand aim of the higher education. No doubt the knowledge of facts is important, but to be able to grasp general principles is surely of far greater importance. Even on the score of utility it must be acknowledged to be preferable, and a scheme that makes the logical connection of the sciences give place to a mere knowledge of disconnected and fragmentary particulars is in the highest degree anti-utilitarian. If the *alumni* of our Universities are to have a training in Physical Science at all, let that training, however limited, be at all events scientific. Bacon's Simile of the Pyramid affords an excellent model of a true system of education. We must first lay down a broad foundation of facts. This should begin in the schools. Indeed, that should be *then* the sole aim. But in the colleges, along with continuing to treasure up facts, the aim should be rather to point the students to the apex of the pyramid, in other words, to teach them to generalize, and thus to reduce facts to unity.

Taking the scheme as it stands, the question of its practicability deserves the most serious attention. As I am called upon to give free utterance to my opinion, I beg to say, with all deference to the more enlarged experience of those who have drawn up this scheme, that I am not at present, and speaking generally, very deeply impressed with a sense of its practicability, or to put it in the mildest terms, I am not so sanguine of its success as the Committee seem to be.

First, there will be the enormous outlay,—not only the original cost of providing the instruments, but the continuous cost of keeping them in working order, and supplying the requisite materials for carrying out the experiments. Doubtless, the Committee have counted the cost, but they have not told us whether there is or will be any definite provision made to meet this increased expenditure. From what they say, however, in connection with the minor schools, we are left to gather that it will depend very largely, if not entirely, upon the open-handedness of the people. That it will press very heavily

upon the resources of a large number of each schools, is, I think, very probable; and, indeed, the Committee are fully alive to the fact that this consideration may, to a certain extent, interfere with the effectual working of their scheme; or that such schools, owing to reasons of economy, may be tempted to resort to the aid of some cram-book in order to coach up their boys to the Entrance Standard. They, however, hope and believe that this will be only partially the case. I hope they may not be disappointed. In many cases economy will, doubtless, be pleaded without any adequate reason; in many others, however, the plea will have to be admitted as valid. It does not appear that the Committee propose any definite and effectual remedy for this anticipated evil. But they trust that the 'inherent attractiveness' of the subject itself, the power of fascination which experimental science is known to have over the Native mind, will prove a sufficient inducement to the procuring, on the part of the Natives themselves, of all that is requisite for the effectual working of the scheme. I regret I cannot look at the matter in the same hopeful light. I cannot believe that this fascination, granting its existence, will, as a general rule, prove an 'open sesame' to the purses of the people. A mere temporary enchantment without a continuous stream of enthusiasm is not much to be relied on. As, then, this power of inherent persuasion may probably, and doubtless will in many cases, prove a failure, it is clear that measures of a more definite and compulsory character should be provided if the scheme is to be carried out at any cost.

Accordingly, in order to the effectual working of this scheme, it will be necessary, I imagine, to adopt one or other of the following expedients: *1st*, either to exclude from the Entrance Examination all schools that will not or cannot provide *themselves* with the requisite apparatus; or *2ndly*, to look to the *State* to make provision for all schools alike, or, at least, for those whose means are found to be too slender to provide for themselves. The former expedient would no doubt press very hard upon, and be deemed very unjust to, many poor but deserving schools, and would, in all probability, retard the educational movement very materially. But, on the other hand, consider what a heavy burden the adoption of the latter alternative would entail upon the State. The name of schools seeking for the needful assistance would be found to be Legion.

In the next place, to say nothing of the additional expenditure that will be incurred in conducting the annual examinations, such as for providing botanical specimens for the First Arts candidates, and sending experienced examiners to remote centres to see that the examiners are provided with suitable specimens, &c., it will, I imagine, be found to introduce so much complexity into the arrangements as to render the machinery too cumbersome to be successfully worked, specially in those places where the number of candidates is large.*

In the third place, where are the men to come from who are to teach these subjects, in the only way in which the Committee say they must be taught, if taught at all? This question presses seriously on our attention, and requires to be definitely answered. It is not enough that every college and school is provided with suitable instruments: there must be men there who are capable of working them successfully.

Skilful experimenters are as requisite as good apparatuses; and, supposing the difficulty of procuring the latter to have been got over, what guarantee have the Committee of being able to raise an adequate supply of the former within any reasonable period. Granting that the difficulty is one which may soon be overcome in our large towns and at the chief centres of learning, still there is the vast number of zillah and aided schools to be provided for. It requires a pretty considerable amount of natural genius, no less than training, to make a successful experimenter. Whatever of 'Village Hampdens,' Village Faradays must, I imagine, be very rare birds—few and far between.

The proposal to bring the Head Masters of country schools to Calcutta for a month or so in the cold weather for the purpose of teaching them to

* Great as is the skill evinced by the Registrar in conducting the examinations, considering the vast area over which they extend, I fear that to work successfully such complicated machinery as this scheme proposes, would over-tax even his powers.

manipulate the instruments, is a measure which, I cannot help thinking, would even, supposing it to be generally feasible, turn out but very indifferent results. And, indeed, the Committee seem to feel this, hence they deem it advisable to supplement this at first by employing trained teachers of science to visit the principal schools, in order to give instruction both to the masters and their classes in the use of the instruments. Disregarding the question of cost, this would doubtless be the more satisfactory method, and it might supersede the necessity of an annual influx of masters to Calcutta. But then look at the number of agents that would be required for this purpose, and that, too, for a much longer time, I fear, than the Committee at present contemplate.

I regret I cannot share in the confident expectations of the Committee of being able to tide so readily over the difficulty of getting men for their purpose. For the Drawing Department, it appears, they have been guaranteed a ready supply at a moment's notice. It will probably be found not such an easy matter to provide for the other subjects. They are, however, sanguine that, in the course of a year or two, if not *at once*, an adequate supply of indigenous agents will spring into existence, capable of carrying out their design to the full. It is the wish that is father to the thought—a wish more potent than the whistle of Roderick Dhu—

“That whistle garrisoned the glen

“At once with full five hundred men.”

And, now, as to the mode of introducing these new subjects, and the place they are to hold in, what we may well call, the new curriculum.

First as to the Entrance Course. The Committee are of opinion that there will be no necessity for excluding any of the present subjects, on the contrary that additions might be made to them with advantage, because they have been told on competent authority that the present course is insufficient to occupy many of the candidates up to the age of admission to the examination. But a reference to the results of the examinations will show that such is not the case. The number of candidates who succeed in getting half marks and upwards, is very small as compared with the number that fall below, and all who have had to do with these examinations can bear witness to the fact of the very crude and imperfect information the papers generally display. There are instances, no doubt, of boys who have attained the requisite degree of qualification before the proper age for admission, but such instances are known to be very rare. Accordingly, if additional work be put upon their shoulders, it is clear that the number of failures will be necessarily much greater. If the Committee had said, we deem it advisable to make additions to the present Entrance Course not because the candidates have not sufficient to occupy them, but because irrespective of that, we deem the present standard too low, whatever difference of opinion there might be as to the merits of the standard, their line of proceeding would have been more straightforward and intelligible. But in the light the Committee have chosen to put the matter, we are surprised to find, contrary to all our experience, that the entrance boys and consequently their matters have an easy time of it. It is clear that those who have put this idea into the heads of the Committee, have had nothing to do with teaching that class of boys.

Accordingly, if the scheme proposed be enforced, the Committee must be

* In the Punjab University it has been found necessary to reduce the Entrance and First Arts Standard to the level of those of the Calcutta University. This might be urged as a practical proof of the desirableness of leaving the present standards alone.

prepared to find, in all probability, a large diminution of the number of successful competitors.* And, no doubt, there are many who would by no means consider this a matter of regret, deeming numbers of much less consequence than quality.

In accordance with what I have already said at the outset of the desirableness and importance of an early introduction of some knowledge of Natural and Physical Science, I think with the Committee that these subjects might be advantageously introduced into the schools, and should be recognized as an essential part of the Entrance Standard. But to prevent the latter from

being rendered too difficult, the amount of knowledge required should be as elementary as possible, and I would by no means insist so exclusively on the *experimental* character of the teaching. Of course individual schools may adopt this line of teaching if they choose, but since, in respect of men and means, the many would be placed at a disadvantage as compared with the more fortunate few, I think nothing beyond simple book-knowledge, and that of a general character, should be required at the examination. In framing his questions, the examiner might ask them simply to *name* certain things as practical illustrations of the subject on which they are being examined, but nothing more. In the majority of cases I am persuaded that this will be found to be all that is really practicable. Again, in reference to Drawing, I think that, too, might be introduced into the schools with advantage, of course confining it to its most elementary stages—the drawing of outlines, geometrical solids, and the simplest rules of perspective. Besides being an excellent discipline in itself, it would in some measure prepare them for a more ready understanding of certain subjects in their Arts Course which presuppose a certain acquaintance with these things.*

* *e. g.*, the Chapters on Vision in Reid's Essay.

I do not, however, agree with the Committee in thinking that this subject should form an essential part of the College Course. They themselves acknowledge that it is only as an auxiliary to science that it can lay any claim to a part in the curriculum. It should then be treated not as an essentially separate subject, but only as subsidiary to those branches to which it is essentially subservient, and I think after the start given in the schools, it should be left entirely to individual practice.

In reference to both the above subjects, I think it would be desirable to begin with them as low down in the schools as possible, in order to stave off any undue pressure of work from the entrance class, so that the subjects now taught, which, of course as fundamental, are of the first importance, should not suffer any neglect.

In providing for the admission of the new subjects into the First Arts and B. A. Course, the Committee find they have a more difficult task to accomplish, since these classes, unlike the entrance, are already sufficiently weighted with work. Accordingly, additional work being out of the question, the only alternative left is to introduce certain important changes into the existing courses.

Two alternatives are proposed,—either to make some of the present compulsory subjects optional, or to exclude them entirely. The Committee do not undertake to decide what should be excluded, but as the practicability of their scheme depends upon such some measure, they cannot entirely ignore the question. Assuming that it is not desirable to strike out any of the present subjects, two courses are open, either of which will admit of the object they have in view. The first course is to make all the subjects (except English) that are now compulsory, together with the present optional subjects, *optional but not alternative*. This would leave the students free to choose the Physical Science subjects in preference to some of those in which they are at present examined. The other alternative is to make these sciences *compulsory*, and to remove one or more of the present compulsory subjects, for example, Mental and Moral Science, to the optional list. The Committee are evidently inclined to the latter course, as it involves the least interference with the present system.

In reference to the First Arts Course, I am prepared to concede that Mental and Moral Science might be either dispensed with, or rendered optional (but only on condition that these subjects be not interfered with in the Third and Fourth Year Classes), thus leaving room for the introduction of the Natural and Physical Sciences, though not in the form contemplated by the Committee, but rather theoretical, not only as being better suited to existing conditions, and doing away with all unfairness arising from the possession of superior local advantages among the competitors, but also, and chiefly, as being more in accordance with what I conceive to be the character of a liberal or University education.

In reference to the B. A. Course, however, I beg to say that I cannot give my assent to either of the alternatives proposed by the Committee. The present obligatory subjects being fundamental and of the most universal character, are one and all indispensable. I cannot help thinking, therefore, that to exclude any of them, or even to render them optional, would be a most unwise step. The second alternative seems to imply this, except in the case of Mental and Moral Science. It seems to say Metaphysical Science is a speciality of a very unpractical character not by any means to be compared with Physical Science in point either of universality or of usefulness, we may, therefore, label it as unnecessary. It is not my place to advocate the claims of this science even if I were able. All I will say is, that it is a subject which has occupied a large majority of the greatest minds of all ages; that it has monopolized no inconsiderable section of the noblest literature of all civilized countries; that it has always stood in the front rank of those subjects which are deemed essential to a liberal training, and in spite of

• Mill speaks of Comte's neglect of Psychology as

Comtean* tendencies I venture to say it



सत्यमेव जयते

M E M O R A N D U M .

THE Physical Sciences, unless when they are studied for professional purposes, are, as a branch of learning, more *ornamental* than *useful*, and, when they are taught without experiments, are rather *theoretical* than *practical*, the truths investigated having apparently little relation to the concern of life. The Committee, therefore, while recommending the introduction of Natural and Physical Science into our colleges, have thought it proper to guarantee that the study of the science shall be both *practical* and *useful* in its results; in other words, that it shall not, on the one hand, end in a string of formula for the memory, nor degenerate, on the other, into a mere manipulation of apparatus, affording only a moment's amusement, but leaving no permanent impression, nor conveying, in any appreciable degree, valuable information for after-life; and such a guarantee, from such a quarter, ought to satisfy all parties.

I am afraid, however, there may be difficulties in making the introduction of the science *practicable*, at least in the way suggested. The Committee's scheme may be thus summarized :

- (a.) That subjects connected with Natural and Physical Science may with advantage be made to supersede "certain subjects" now in the course;
- (b.) Or, that "certain subjects, " which are now *compulsory*, may be removed "to the category of *optional* subjects;"
- (c.) Or, that all the subjects (except English including, no doubt, both *language* and *literature*) "which are now compulsory, as well as the present optional subjects," may be made "*optional*, but not *alternative*, subjects of examination."

Now, there are subjects in the course (History and Mathematics or Logic for instance) which cannot be altogether *set aside* to make room for the Physical Sciences without materially affecting the character of the education now given in our schools and colleges; nor can they be made *optional*, for such a stage, besides necessitating an immediate re-classification of the boys, a re-distribution of the work of the professors, and other vexatious changes, may divert attention to studies comparatively of little intrinsic value. It is, perhaps, well known that our boys do not unfrequently take up *optional* subjects from other considerations than that of a strong liking, or a peculiar aptitude, for them.

The Committee very justly observe that "experiments in Magnetism, Electro-magnetism, and similar subjects are known to be most fascinating to the acute Bengalis (young and old), and even a glass pump or syphon attracts the close interest of the uneducated coolie." It is on account of this "inherent attractiveness of experimental physics" that I would beg to suggest that the study of *Natural and Physical Sciences* in our colleges be made *optional*, and that the "certain subjects" alluded to, along with Mental and Moral Sciences, be allowed to continue in the list of *compulsory* subjects. At the same time, to meet the views of the Committee, lectures on Natural and Physical Sciences may be delivered twice or three times a week during college hours; and if the time now given to History be reduced, those lectures may not be found to interfere with existing arrangements.

Drawing had a trial in the old Hindoo College. It had a trial in this College also, but the result, I believe, was not satisfactory. Perhaps, under better auspices, it may be taught with greater success.

ESHAN CHUNDRA BANERJYA,

Professor of Hooghly College.

From Rev. H. W. SHACKELL, M. A., Officiating Principal of Joy Narayn's College, to the Registrar of the Calcutta University.

I HAVE received your memorandum of the 9th instant, requesting a full expression of my opinion on the scheme suggested by the Committee to report on the best mode of introducing the study of Natural and Physical Science into schools and colleges in India.

I must preface my remarks by expressing my full approval of the proposal, thinking that the study of Natural Science might, to a great extent, be most advantageously substituted for some of the subjects at present required in the University Examinations. I also think that Drawing will form a very valuable addition, and that the scheme drawn out by the Committee is, on the whole, a very valuable one.

I have, however, my doubts as to some of its subordinate details.

1. I think that the scheme of studies already in use for the Entrance Examination is quite sufficient to occupy the time of the students who prepare for it, at least in these Upper Provinces. If I am correct, it will be necessary to shorten the present scheme in order to allow of the introduction of the new subjects, and I should be inclined to the opinion that the most advantageous way of effecting this object would be to abbreviate the subjects for the English course now prescribed from year to year. I should also be of opinion that some part of the Physical Science Course proposed for the Entrance Examination, preferably that relating to Magnetism and Electricity, would be better postponed to a subsequent period.

The Committee has already proposed to omit some of the subjects in the First Arts and B. A. Examination in order to make room for those proposed in Physical Science. This will, of course, be necessary, and I conclude that what are now called the optional subjects will be altogether omitted. But I think that, if possible, to abbreviate the English course for the B. A. Degree would be preferable to omitting Mental and Moral Science.

These are the principal remarks that occur to me on the subject.

Dated the 18th August 1871.

From REV. S. DYSON, Principal, Cathedral Mission College, to J. SUTCLIFFE, Esq., Registrar.

I BEG to acknowledge the receipt of the "report on the best mode of introducing the study of Physical Science into the University scheme of education," and to give you, as requested, an expression of my opinion on it.

2. The benefit of an acquaintance with the truths of Natural Science is not a matter of question. The report, proceeding on the assumption that the study is *especially* useful, proposes to select such branches of it as are more specially useful, as being of a *practical* character, and as capable of being taught with comparative facility. These subjects are to be in addition to, or in substitution of, those already prescribed by the University.

3. Passing by the consideration of the subjects selected with this one remark that they cover a very wide field, and are thus open to the objection which is frequently urged against the scheme already in force, *viz.*, that a smattering of everything is taught and nothing effectually, I shall direct my remarks mainly to the *practicability* of the scheme proposed. It will be understood that additional elements of difficulty are imported into the question from the fact of the establishment and development of a system of education in Bengal, which would not have existed had this study been comprised within the system of University education from the first. These difficulties will present themselves as the various proposals of the report are examined in detail.

4. The practicability of the plan is obviously two fold,—(a) the practicability of teaching these subjects, and (b) the practicability of examining the results of the teaching. Seeing that the scheme is to be engrafted on the University system of examinations, it is plain that, however easy the former may be, a failure in the latter point will be fatal. The University cannot recognize any teaching, the value of which cannot be, approximatively at least, measured by its system of examinations. I shall discuss the scheme with reference to these two points in detail, and subsequently make such general observations as may seem useful.

5. It is proposed to add the VI. Book of Euclid and questions on Elementary Natural Philosophy to the subjects already prescribed, on the ground that

Entrance Examination.

this examination is now too easy. The Committee accept this fact on the testimony of certain "well qualified" persons who have stated that "the present course is insufficient to occupy many of the candidates up to the age of admission to the examination." Without intending to disparage the competency of these persons, I may still express the opinion that an appeal to their testimony was superfluous. Their opinion, however valuable and authoritative, cannot surely be more valuable and decisive upon this question than the facts and figures already in the possession of the University. An ignoring of the University statistics of the Entrance Examination and a resorting to the evidence of mere opinion excites a doubt, in my mind, whether the fact upon which this recommendation is based is quite so certain as the Committee suppose. The answers to the following questions which are easily procurable from the University rolls, will determine the character of the alleged fact. What proportion does the number of successful candidates bear to the whole? What proportion does the average number of marks secured by the successful candidates bear to the maximum number attainable? My impression is, that the result of this investigation will not bear out the assumption upon which this proposal of the report proceeds.

6. If this impression should turn out to be well sustained, the scheme, *quoad* the Entrance Examination, falls to the ground. If scholars cannot well learn more and other subjects than they are now learning, it is idle to inquire further in what way qualified teachers may be procured to instruct them. But, again, the plan of securing such well-qualified teachers sketched in the report seems to me to be open to remark. It is quite possible that teachers subjected "for a month or two in the cold weather" to Mr. Woodrow's instruction, may be able on their return to "*manipulate apparatus*" and "*exhibit* to their scholars and occasionally to the parents and friends," but whether in any proper sense they will be *teachers* of even elementary sciences appears to me very doubtful. Without dwelling on the national character, or the absence of any groundwork in the previous training of these teachers for the reception of this science, it is just possible that, instruction having to be received and imported in a foreign language, these teachers may not be so conversant with English as to be able to vary their language, or to convey the modicum of scientific information they have received, in any other terms than those in which they have received it. But if all head teachers of schools, whose standard is the Entrance Examination, were adequately familiar with the English language, the capacities of their pupils in this direction are very limited, and on this account, I think, the teaching of elementary science by even trained and competent teachers, so long as it must be through the medium of the English language, will be to a great extent abortive. But if the difficulty of teaching science to this class of students is great, the difficulty of examining is greater still. If the pupils in their examination are not to describe these experiments, which are the subjects of examination in the *ipsissima verba* of the explanations afforded by their teachers, I fear, with their meagre stock of words, they will not be able to write down any intelligible account at all. Nor is it easy to perceive how in the University examinations it will be practicable to guard against that parrot-like repetition of words which is so frequently complained of, and which, moreover, it is one of the professed ends of this scheme to prevent ("it shall inculcate a knowledge of things in contradistinction to mere book-knowledge".—Report p. 1.)

Competent teachers of science manipulating apparatus, and in the elucidation of their experiments employing a *vernacular*, rich in mechanical and scientific terms, are on a different footing, and one sees at a glance the feasibility and great benefit of the proposal of the London School Board Committee to have a "highly qualified special lecturer who shall travel round to each school of his circle in return and deliver there a special course;" but the scheme when transferred bodily to Bengal is beset with difficulties.

7. *First Arts*.—The reasons alleged in the report for including the Art of Drawing among the subjects of the First Arts Examination do not appear to

me to be of any *special* value. Every art and every science is useful, and a professor of each naturally thinks his own the most useful. It seems a truism to say that "nothing cultivates the faculty of observing form and proportion so much as the practice of elementary drawing in outline." The practice of every art cultivates some faculty or other of observation.

8. It is very likely that the teaching of perspective will lessen or remove the difficulty experienced in teaching mathematics mentioned in the report, but if the teaching of Drawing in college involves difficulties itself not less than the difficulty it is introduced to remove, no gain occurs from the proposed change. I speak with some diffidence on the subject, but, I think, the difficulty felt is very much mitigated by the use of solid models, boxes of which are easily procurable. Drawing may "be conceded to have a very high value as an auxiliary to the teaching of science," but I do not perceive how this follows from the fact of its lessening the difficulty of teaching one branch of mathematics as the report apparently makes out. It must be remembered that the claim of drawing to be taken into the University scheme rests upon its qualification of its comparatively great utility. I do not see that the report substantiates that claim.

9. Assuming, with the report, that the difficulty of providing teachers of Drawing may be met by the promised supply from the School of Art, it may yet be doubted, whatever their competency as regards drawing whether they would be able to secure that attention and respect from a large class of undergraduates which is essential to good and successful teaching. This is, no doubt, a very minor point; but I am convinced that the maintenance of efficient discipline and the training in orderly habits of obedience and respectful deportment are very important elements in any system of education, and are in some danger of being neglected in the present naturally and properly great anxiety to stand well in the University Examinations. But beyond this the magnitude of the change in our established collegiate system, in our buildings and apparatus, which the introduction of this subject into the First Arts Course involves, is very great, and has not, I venture to think, been duly considered. Putting aside the expensiveness to the pupils, it is appalling to think what radical and extensive alterations must be made in the size, arrangement, and equipment of our class-rooms to ensure this Art being efficiently taught. Our First and Second Year College Classes are unusually large, and very spacious rooms are requisite now to hold the students, closely packed as they are in circular galleries, tier upon tier. Given the class of 70 undergraduates in the Presidency College crowded in a disproportionately small room, to explain how they are all to be taught drawing simultaneously, is a problem which the Committee apparently have not attempted to solve, but the attempt must be made and successfully ere this proposal should be accepted. It seems to me to be superfluous to go further into this subject. Is it expected that we must pull down our college buildings and re-construct them with special reference to the requirements involved in teaching the Art of Drawing? Mr. Locke "has fully satisfied the Committee" that *examination* is feasible, but then, as the report seems to imply, as regards the *subject* only. Has he fully satisfied them also as regards the *numbers* to be examined at one time and in one place? Are there examinations held anywhere at all comparable in magnitude to those conducted by the University of Calcutta?

10. The introduction of physical geography of India into the course calls for no remark. It is a practical and practicable subject. It may be introduced, provided we do not thereby violate the necessary condition of keeping within the average capacity of the students to master the multiplicity of subjects prescribed.

11. Our large classes, again, seem to be no slight difficulty in the way of that *practical* teaching of botany which the report proposes to introduce. The professor may be able, perhaps, by ransacking his own or his neighbour's garden, or by investigating the outskirts of Calcutta, where strolling about is possible, *i. e.*, in the cold weather, to procure a sufficient number of specimens for his class individually to "diagnose," and, as it is *practical* teaching that is required, it is possible, I suppose, for the professor occasionally to go out on a

botanizing excursion with his class of 50 or 70 pupils at his heels ; but the prospect does not look encouraging.

12. But the difficulties which gather around the practical teaching of Botany seem to culminate in the yearly examination held in Calcutta. It will baffle you, I am bold enough to think, with all your experience, to accomplish a trustworthy and honest examination in Botany, if the practical character described in the report of the host of candidates who yearly present themselves. Admitting that specimens of the same order of plant may be procured for the examination in the range of country extending from Lahore to Calcutta, yet how is the requisite number of plants to be collected and brought into the examination hall without the examinees getting to know previously what the selected plants are? The examination papers are now sent to England to be printed, and we all know why. The difficulty which has necessitated recourse to this extraordinary precaution will have to be met in conducting the botanical examination. Is there any prospect of its being successfully met? The Committee in their report speak of this difficulty in the following terms: "With respect to Botany, there may be at first a little trouble in carrying out the practical (that is, the most valuable) part of the examination." I confess it has not occurred to me to describe the difficulty of executing this portion of the scheme as "*little*."

13. I think it is unnecessary to sift very closely the mode of teaching and examination of other subjects proposed to be introduced in the F. A. and B. A. Courses. There is one objection which attaches to the scheme as a whole, but which reaches its climax, I think, in the introduction of Chemistry : I refer to the excessive costliness of the scheme. Each subject will necessitate the entertainment of a separate highly paid professor, and he must be supplied with all requisite materials and instruments. Has any estimate been formed of the probable cost of introducing the entire scheme? Chemical materials and apparatus are very expensive ; the materials rapidly deteriorate in this climate, and must be replaced ; and altogether the introduction of the scheme will be so very costly that, *with the present arrangement of grants-in-aid and students' fees*, the managers of aided colleges may well pause to consider whether they can, consistently with other claims, carry on their collegiate system of education.

For it is quite impossible to suppose that they can ever consent to view this question without any regard to its costliness. "The difficulties," says the report, "must be met and overcome, at whatever cost of exertion and pecuniary outlay." The Education Department, which has an exhaustless purse to draw upon, *if it has*, may justifiably put considerations of expense on one side as so many impertinences, but other bodies, not so fortunately circumstanced, are not able to look at the matter quite in that light. The excessive costliness is, I submit, a very serious obstacle, and some intimation should have been given as to the way in which it was proposed to deal with it. Will the Government, in addition to the present grants-in-aid, furnish the aided college with Professors of Natural Science, and undergo the whole or part of the cost of the materials and appliances? Or is it proposed to cover the expense by proportionately raising the fees of college students? It is obvious to remark that, if they are raised very much, we may, perhaps, not get more money, but we certainly shall have fewer pupils, and in that case some of the difficulties mentioned already will so far be lessened. Of course it would then be a question whether such a result would be an indication of growth or decay of education in Bengal.

14. In considering the practicability of the scheme, we should not, I think, neglect the teachings of what little experience we have had. Physical Science does now enter into the scheme of University studies ; it forms one of the optional subjects of the B. A. Examination. It may be quite true, as the report states, that this subject possesses an "inherent attractiveness" not owed by the other subjects of examination, but the fact does not obtrude itself on our notice in glancing at the results of the University Examinations. The subject is not taken up in any of the Mofussil colleges, nor in any of the aided colleges in Calcutta. It may be alleged that there are no facilities in

these colleges for teaching this subject. This is quite true, but the fact shows all the same that the subject, whatever its "inherent attractiveness," has special difficulties. In the Presidency College, however, there are facilities; there is a special professor, there is apparatus, there are materials; and the following questions present themselves: what is the percentage of the whole number of B. A. candidates from this college who take up this subject? And (for I must contend that the cost is an element in the decision of this question) what is the cost of tuition in this subject compared with the cost of teaching any or all other subjects now enforced?

15. There is one obvious feature of the plan which appears to me to be an objection. I allude to its revolutionary character. The great and extensive changes it will entail on the present established system of English education can scarcely be otherwise characterized. Is not the scheme likely to fail simply from its attempting too much and at once? Seeing that there is a system which has taken root and is growing apace, it seems to me that any change, which is to be an improvement, should, in some way, be connected with it as a natural outgrowth and development, or, at all events, such as, without much uprooting, may, with comparative facility, be engrafted on the present system. It does not strike me that the plan proposed does possess any such desirable quality.

S. DYSON,

Principal, Cathedral Mission College.

Dated Calcutta, the 18th August 1871.

From the RECTOR of St. Xavier's College, to J. SUTCLIFFE, Esq., M. A., Registrar of the Calcutta University.

IN your note of the 9th instant you requested me to submit to the Syndicate a full expression of my opinion on the scheme suggested by the Committee to introduce the study of Natural and Physical Science into schools and colleges in India.

To comply, Sir, with your request, I beg at once to state that to this impending decision of the Senate I naturally attach much importance, as it involves a radical change in the educational system.

In the new scheme it is proposed to add to the present list of subjects:

(I.)—For the Entrance (1) the VI. Book of Euclid, (2) a schedule of Experimental Physics, Statics, Hydrostatics, Pneumatics, Heat, Magnetism, &c.

(II.)—For the First Arts Examination (1) a schedule of Botany, and (2) of subjects in Chemistry, Drawing, &c.

Moreover, the Committee proposes, as the best alternative, to make these sciences compulsory, and to remove to the optional list one or more of the present obligatory subjects, for instance, Mental and Moral Science.

This plan, says the report, will probably recommend itself to the Senate as being most effectual to the present object, and as involving the least interference with the present system.

I cannot enter into all the details of the proposed scheme, which, in some respect, seems to have been carefully prepared; but, with all due deference to the Committee, I must decidedly object to three of the principal parts of the plan:

(1.) I object to the project of removing Mental and Moral Science to the optional list. In every civilised country Mental and Moral Philosophy appertains to the essential parts of a solid education, and consequently cannot be made optional without destroying the very foundations of the educational system adopted by the University. The present system of the University is sound and rational, and wants only to be strengthened and improved, but should not be radically changed, as suggested in the scheme proposed by the Committee.

(2.) I object to the intended purpose of making Physical Science the subject of the Entrance Examination. In planning the new scheme, I fear the Committee lost sight of the subjects which belong essentially to the College Department, and of those which naturally take their place in the School Department. If this distinction be not carefully kept in view, it is not possible to classify systematically the subjects for University Examinations. Up to this time Physical Science has been admitted as an integral part of the curriculum of the higher studies, and, therefore, should be classified among the subjects of the College Department only as a necessary condition to the attainment of University Degrees. This scientific subject belongs by no means to the School Department. Why then should we make it a subject of the Entrance Examination, or a condition *sine qua non* for the student to enter the College Department? It is my decided opinion that the study of Physical Science should be kept in its proper sphere, and that it should be duly encouraged and promoted in the B. A. Classes. As long as the teaching of this science is not on a better footing in the colleges, it is of no use to extend it to the Higher Class Schools, where the boys, in the present state of education in India, are perfectly unable to understand the principles and laws of this science. I am convinced that the introduction of Physical Science into *schools* will be a waste of time and labour, a waste of public money. At all events, a superficial notion of physical experiments, as taught in schools, may be made the subject of school, but never of University, Examinations.

(3.) The argument of the preceding paragraph applies, *a fortiori*, to Drawing. Drawing is certainly useful, and should be taught and encouraged in every well-organised educational establishment; but because Drawing is taught in a school or in a college, must it, therefore, be considered as an integral part of the higher studies, and, as such, become a subject of University Examination? I do not think so.

To comply, Sir, with your request, I have frankly expressed my opinion on the proposed scheme of the Committee. I hope that no offence will be taken at these remarks, which I submit to the authorities with no other view than to maintain a sound system of education in India.

No. 108, dated Dacca, the 19th August 1871.

From W. BRENNAND, Esq., Principal of the Dacca College, to J. SUTCLIFFE, Esq., M. A., Registrar of the Calcutta University.

I HAVE the honor to acknowledge the receipt of your memorandum dated 9th August 1871, forwarding a Report of the Committee appointed by the Syndicate to report on the best mode of introducing the study of Natural and Physical Science into the schools and colleges of India, and requesting my opinion on the scheme suggested.

2. The plan of the Committee may be considered, first, with reference to the manner in which it will affect schools, and, secondly, with regard to the changes which are proposed in the course of study of the colleges.

3. In schools it is recommended that in the course of Geometry the VI. Book of Euclid should be added, and that at the Entrance Examination questions should be given on an elementary course of Experimental Science.

4. That a higher standard in Mathematics might, with advantage and without inconvenience, be introduced in the schools, does not admit of any doubt. Before the establishment of the University, the course in Mathematics in schools comprehended a higher range of subjects than it does at the present time. In Geometry it included the VI. and XI. Books of Euclid, and Algebra was taught as far as Quadratic and Simultaneous Equations. I have never been able to perceive that any advantage was gained, either to the teachers or to the students, in the reduction of the standard of the Entrance Course in Mathematics. The work was not considered to be too great a task for the student, for he had all the time before he was 16 years of age to prepare for the examination, and the system had been working well for some years in Government schools.

5. The bad consequences of the change have been felt ever since, for all the work excluded from the Entrance Course was added to the four-year course of the college, impairing the teaching of every branch of study both in Literature and Science. I think it very desirable that a higher standard should be fixed in Mathematics at the Entrance Examination.

6. The second alteration in the course for schools recommended by the Committee is the practical illustration of the elementary principles of Statics, Hydrostatics, Pneumatics, Heat, Magnetism, and Electro-magnetism.

7. The advantage of such an experimental course for the Entrance Examination is obvious. It would be no great addition to the labors of the student, for he would not be called upon to perform the experiments himself, he would merely be required to give his attention to the explanation of the teacher and to the description of the apparatus as given in a short course prepared for the purpose. The simple rules of science would be best taught in this way by actual reference to facts, the reasons and demonstrations as a part of education would be taken up afterwards in the colleges from systematic treatises.

8. With regard to the means for introducing this practical course in schools, there are difficulties which can only be surmounted by a large outlay of money. If a practical knowledge of science is to be enforced at the Entrance Examination, there must be the means afforded for teaching it in every school from which entrance candidates are sent. There must be qualified teachers and apparatus to illustrate the elementary text books.

9. The proposal of special lecturers, to travel from school to school, would probably be the most feasible plan; the difficulty here, however, would be the training of a sufficient number of highly qualified teachers, who would need to be instructed in the use of philosophical instruments in manipulation, and in methods of preparing experiments for which apparatus were not provided.

10. In Calcutta and other central stations, classes would have to be formed for training teachers in the special duties they would have to perform; for this purpose the services of Professors of Natural and Physical Science would be required.

11. In the beginning, the teaching of physical science could only be very partial, and the examinations for a long time would be restricted to questions from the text book, and the effort to introduce such sciences would resemble the similar attempts that have hitherto been made.

12. In the course for the Entrance Examination in 1856-57-58 there are set down in Natural and Physical Science—

Vegetable Physiology as in Chambers.

Patterson's Zoology and a popular course of mechanics.

The Syndicate will know the reason why these subjects have been omitted in the Entrance Course of subsequent years.

13. In the scheme of the Committee, as far as it regards the first two years of the college course, it is proposed to introduce three out of four of the following subjects for the First Arts Examination :

- | | |
|-------------|---------------------------------|
| | 1. Drawing. |
| | 2. Physical Geography of India. |
| Optional. { | 3. Botany. |
| | 4. Elementary Chemistry. |

14. It is admitted that the candidates for this examination have already quite as much work as can be accomplished in the time allowed, and that it will be necessary either "to make all the subjects (except English) which are now compulsory optional, but not alternative subjects of examination," or "to make these sciences compulsory, and to remove one or more of the present obligatory subjects, for instance, Mental and Moral Science, to the optional list."

15. The difficulty in the way of teaching optional subjects in colleges where the staff is limited, is the multiplying the labours by splitting up classes into sections reading different subjects, thus requiring the labour of a greater number of professors than would be necessary if the classes were integral and reading only single subjects. The experience hitherto of students reading optional subjects has been confined in a great measure to the Presidency College. In a Mofussil College the subjects must be of the nature of compulsory subjects, until larger staffs are provided. For if a professor can only take one out of two alternative subjects, that subject, whether it be Natural Science or Mental Science, becomes in a Mofussil College a compulsory subject to all the students of the same year.

16. To make all subjects optional, except English, would leave the Mofussil Colleges as they are, for then the optional subjects taken would comprise just the subjects that are now compulsory, unless additional professors were appointed for additional work.

17. The other alternative proposal of the Committee, namely to make Natural and Physical Science compulsory, would, if the change were made suddenly, produce great confusion. It supposes that Natural and Physical Science might properly supersede one or more of the subjects now taught. Either then there must be an entire displacement of one or more of the present subjects, or there must be a pure addition to the present course of the new subjects in Natural and Physical Science. Now it would scarcely be reasonable to expect a Professor of Mental and Moral Science to undertake the duties of a Professor of Natural and Physical Science, much less would it be likely that he would take this work in addition to his own legitimate duties. Hence, if these sciences are to be introduced in a compulsory form, an additional professor or assistant professor would be required in each of the colleges.

18. Should the scheme for training special teachers of physical science be carried out by the appointment of Professors of Natural and Physical Science, it might be possible to arrange that the candidates of the First Arts Examination, who elected to read physical science, should attend their classes.

19. If, however, special professors were appointed to each of the colleges for teaching Natural and Physical Science, it might then be a question for the Syndicate if it would not be advisable to extend the college course to five years, so that physical science might be introduced without producing any alteration in the present course.

From Rev. R. JARDINE, B.D., Principal, General Assembly's Institution, to J. SUTCLIFFE Esq., M. A., Registrar of the Calcutta University.

IN accordance with your request I herewith beg to lay before you my views regarding the scheme suggested in the "Report of a Committee appointed by the Syndicate to report on the best mode of introducing the study of Natural and Physical Science into schools and colleges in India."

With the general spirit of the proposals contained in that report, I cordially sympathise, as, unquestionably, the Natural and Physical Sciences do not now hold that position in the scheme of general education in India to which their importance entitles them.

The introduction of Geometrical Drawing appears to me a very important element in the proposed scheme, as I have found by experience that our students are peculiarly deficient in that power of accurate observation and analysis which the study of Drawing is well fitted to cultivate. For example, in reading with a class of students Reid's "Inquiry into the Human Mind," I have found it almost impossible to make them understand the distinction between *visible* and *tangible* extension, or to comprehend what Reid calls the "Geometry of Visibles."

This difficulty, a slight study of the principles of perspective, would at once remove.

In the scheme proposed by the Committee I observe that experimental Physics are suggested for the Entrance Examination, and that candidates for that examination will be expected to master this subject throughout nearly its whole extent.

I cannot but express very serious doubts as to the advisability and practicability of this part of the scheme. In the case of those students who contemplate the completion of their college course, it appears to me that the study of experimental Physics would be postponed with great advantage to the students themselves until a later period in their course. Previous to their Entrance Examination they could not possibly have a satisfactory knowledge of those mechanical laws which are necessary thoroughly to understand the experiments which are referred to. The theoretical study of mechanics forms a part of the curriculum of the college, and this later study would be made much more interesting as well as useful by its being accompanied by the experiments proposed for the Entrance Examination. And, although boys in the Entrance Class of our schools might, and doubtless would, take a great interest in such experiments as are proposed, I think it is very questionable if the smattering, which they would thus require of this subject, would be of any real service to them in their future studies. And still further it appears to me that the introduction of this subject into the Entrance Examination would have the effect of taking the attention of the student from other subjects, such as the study of English, on which it is of the greatest importance that they should bestow careful study.

I do not express my opinion as to the practicability of introducing the study of experimental Physics into the schools of the Mofussil, as my lack of experience gives me no right to do so. But would it not be more prudent to *introduce* the subject into the colleges first? and if the result proves satisfactory, subsequent attempts might be made to extend it to other departments.

With reference to the changes which the adoption of this scheme would necessitate in the present college curriculum of studies, the most careful consideration should be given to the subject before coming to a decision. The system of *options* is, I suppose, the best which has yet been discovered for overcoming a great educational difficulty. But I would strongly deprecate the proposal made by your Committee to remove Mental and Moral Science to the list of optional subjects. This subject appears to me the best fitted of all to cultivate a power and habit of independent thought in the minds of the students. And the want of some knowledge of Philosophy in a graduate appears to be such a serious object that no study of Natural Science should be considered a sufficient compensation for it. At the same time I am not prepared to suggest that any other subject at present in the curriculum should be made entirely optional.

But I trust the Syndicate will excuse me for suggesting a scheme of options, which appears to me more satisfactory than any other which I have seen, and has been adopted with good results elsewhere.

The scheme which I would suggest may be briefly summed up under the following heads :

I.—That for the Intermediate or First Arts Examination no subject be optional, every student being required to attain a certain minimum of knowledge in each subject. But in each subject let there be two distinct standards of attainment, the lower standard being obligatory upon all who wish to pass. Let the higher standard require not merely a higher number of marks, but also a greater extent of reading in each subject, and let any student have the privilege of passing in the First or Honor Division in any one or more subjects to which he may choose to give special attention.

II.—That for the B. A. Examination a certain number of subjects be optional in the case of those who have passed in the First Division at the First Arts Examination, the number of optional subjects in each case being determined by the number of subjects in which the student

distinguished himself at the previous F. A. Examination. Let there be for the B. A. Examination the same division of each department of study into the lower or pass course, and the higher or honour course. Thus a student who had passed in the First Division at the First Arts Examination in one or two subjects might drop entirely one or two subjects of the B. A. Course; he might take the lower standard in other subjects, and give his special attention to the one or more subjects in which he might wish to distinguish himself.

This is a very crude sketch of the system which I have in view, and without the necessary details will, I fear, be scarcely intelligible. The advantages to be derived from some such system as this are, I think, manifest. The introduction of the system of options into the B. A. Course to a greater extent than now will have room for the introduction of Natural Science or any other subject. A student who has a special task or ability for some particular subject will have an opportunity of distinguishing himself in it to a greater extent than at present, while at the same time he will be compelled to give so much attention to other subjects as will insure a good general education.

The suggestion made by the Committee that Mental Science should be optional, appears to me invidious, as I see no reason why that subject should be optional which does not apply equally well to every other subject of the course, except perhaps English. By the scheme which I suggest no subject will be optional to any student who has not deserved options by a certain amount of success, that is, a student of this description must master a certain pass course to be fixed by the Syndicate, the whole of which will be obligatory, whereas a student who has proved himself worthy of options will be allowed to drop one or two subjects entirely, and take simply the pass course in others, reserving his special efforts to those subjects in which he wishes to excel. While at the same time in his First Arts Course he will have made himself acquainted to a certain extent with all the subjects in the curriculum, including those which he will be afterwards allowed to drop, if he has shown himself worthy of enjoying options.

All this I beg respectfully to submit.

No. 45, dated the 19th August 1871.

From A. MEARS, Esq., Head Master, Schore High School, to J. SUTCLIFFE, Esq., M. A., Registrar, Calcutta University.

I HAVE the honor to acknowledge the receipt of the report of the Committee appointed by the Syndicate as to the best mode of introducing the study of Natural and Physical Science into schools and colleges in India, with a request that I would furnish the Syndicate with a full expression of my opinion of the scheme proposed.

Two points present themselves for consideration, namely, can the proposed scheme be practically carried into effect? and is the teaching involved of a practical nature?

The first of these considerations appears to me to depend upon four things—

1st, whether the masters employed in the schools are capable of teaching the subjects comprised in it;

2ndly, whether the cost of the necessary apparatus can be met by the several schools;

3rdly, whether the introduction of the scheme would interfere injuriously with the existing course; and,

4thly, whether the subjects are such as the pupils can be examined in.

As to the first of these considerations, we are informed by the Committee that the Deputy Inspectors of Schools under Mr. Woodrow and Mr. Clarke give it as their decided opinion, that the scheme can at once be carried into effect; in other words, that the masters under them are capable; and, indeed,

when we bear in mind that the scheme provides for their instruction in the manipulation of the necessary apparatus, it is difficult to suppose that they could be otherwise, so that, as far as the teaching of experimental science in the schools is concerned, no doubt as to the practicability of the scheme can be entertained. Still less as regards the college portion of the scheme, considering how easily the requisite number of professors and teachers can be obtained for the limited number of colleges which exist.

As regards the subject of expense involved in the introduction of the scheme, that is a matter that can only be satisfactorily considered by the heads of the several schools which the scheme will affect. I can only, therefore, say that, as far as the Sehore School is concerned, I apprehend no difficulty on that score.

On the third point, as to whether the introduction of the scheme would injuriously affect the present course, I am afraid that my very limited experience of schools affiliated to the University scarcely warrants my expressing an opinion. The evidence before the Committee and Senate tends to show that additions to the present Entrance Course can be made with advantage. No doubt that in schools in and about Calcutta, and other large educational centres, this may be the case; but I doubt whether in places devoid of English-speaking Native residents, and where the pupils out of the school-room never hear the English language spoken, this is really the case. One thing, however, in favor of *this* addition to the course is the very interesting nature of the subjects proposed, which being accompanied, as they will be, by such pleasing experiments and illustrations, the pupils may be induced to overlook the extra amount of work involved, even if they should not consider it, as it is not improbable that they would, in the light of relaxation. Should it appear, upon better evidence than I am able to advance, that the course for the entrance would not be made too lengthy by the additions proposed, I have no apprehension of any difficulty in the upper or college courses. The transfer of Euclid Book VI. from the F. A. Course to the Entrance, and the placing the subjects Mental and Moral Philosophy among the optional list, would be a fair equivalent for the amount of new matter entered as compulsory by the second alternative proposed, while there can scarcely be felt a doubt of the beneficial character of the change.

Lastly, are the subjects such as the students can be examined in? The Committee state that among other necessary conditions this was not lost sight of when the list was drawn up, and an inspection of the list is sufficient to show that the condition has been fulfilled.

This review of the four points upon which the practicability of the scheme appears to turn is, on the whole, satisfactory. No doubt there will be many schools in which time will be required for its introduction, and some in which it may never find a place, yet I do not consider that this would be the result of any defect in the scheme, but rather in the schools; for I am of opinion that no scheme of any real value could be devised for which schools could not be found in which its introduction would be impracticable.

It now remains to consider the second point, namely, whether the teaching involved in the scheme is of a practical nature. That it is so, I do not think can be doubted; for, while every truth admits of clear yet simple demonstration by actual experiment, the examples selected to illustrate those truths are of the most homely kind, of every day experience; articles of domestic use, the children's toys, mechanical appliances to be met with everywhere, are all called in to illustrate the teaching, so that its failing to be practical wherever the scheme is carried out in its integrity would be simply impossible. I have always considered that one great and beneficial result of the teaching of Natural Science to the people of India among many others would be the irradiation from their minds of the rooted belief which exists of the supernatural. The addition to the list of subjects laid down, of reflection of objects from plane mirrors and unsilvered planes of glass, and the transmission of sounds by tubes or rods, both capable of clear demonstration by easy yet beautiful experiments, and being as they are the keys as it were to the best illusions in Natural Magic, would tend greatly to that end. I consider that we should not have

done our duty as teachers till the people of India have learnt to attribute to the true causes those wonderful effects of illusion and delusion which in the hands of the Charlatan Natural Science is made to produce, instead of attributing them as they, with few exceptions, do to the agency of the evil one.

It only remains now to say a few words upon the introduction into the scheme of the art of Drawing.

Although, as the Committee state, Drawing cannot be classed under either Natural or Physical Science, yet, in a course intended to teach those sciences, its omission would undoubtedly be a serious defect. This is true even when the pupils are capable of understanding pictorial illustrations, much more so than it is true when the pupils are those to whom the representation of solids on a plane is simply unintelligible. As a good teacher is lost without a black board and chalk, even when apparatus is at hand, it is essential that his pupils should be capable of understanding his sketches drawn on the spot for their instruction. Therefore I consider, on this account alone, it would be necessary that drawing should be taught.

Its omission from the Entrance Course, if the omission can be avoided, is an error since pupils are required to draw diagrams in illustration of experiments in the examination for that course; and secondly, as the study of solid geometry is part of the F. A. Course, a knowledge of the representation of solids on planes is essential when beginning that course. It is the general inability of Native students to understand how three straight lines meeting in a point can represent three rightangles, as would be the case of a cube or other rectangular solid represented in perspective that causes the study of solid Geometry to appear so difficult and to become distasteful.

There can be no doubt that the Committee, in limiting the study of Drawing to the absolute requirements of science, have acted most judiciously, as the School of Design or Art Academy and not the Calcutta University is the proper place for the study of Drawing as an artistic accomplishment.

Dated the 22nd August 1871.

From W. G. WILLSON, Esq., M. A., C. E., Professor, Kishnaghur College, to S. LOBB, Esq., M. A., Principal of the Kishnaghur College.

I BEG to forward, in compliance with your request, the following memorandum on the " Report of a Committee appointed by the Syndicate to report on the best mode of introducing the study of Natural and Physical Science into the schools and colleges of India."

1. The reasons assigned by the Committee for giving such a very prominent place to Drawing and making it a compulsory part of the University course, do not seem to me to be adequate. I shall only consider its use as an auxiliary in the teaching of science, which I consider its strongest recommendation in the present case. "The pleasure derivable from it in after-life" and "the additional power of describing objects and conceptions which it confers," will hardly be allowed to be a sufficient justification for its introduction into the course as compulsory study, while students have other and more serious subjects quite sufficient to occupy their entire attention.

I quite allow that Geometrical Drawing would assist in elucidating those "conceptions relating to space" which the generality of pass students find difficult. It would have another and more important value—the tendency to improve style and inculcate habits of neatness. But these arguments, which would apply with equal force to the West and to the East, have not been deemed sufficient to justify the introduction of Drawing as a general study in European Universities.

The difficulties which the majority of pass students experience in "conceptions relating to space" are not by any means confined in a peculiar degree to Bengali students. These difficulties, in their case, however, are brought more prominently into notice than in the case of European students. First, because they rely, for the removal of difficulties, entirely on their teachers.

A European student takes pride and pleasure in solving problems and in mastering difficulties which may occur in his text books. The Bengali student, who seems to think that his teacher is supplied for the sole purpose of helping him to pass his examinations with the least possible amount of trouble or expenditure of thought on his own part, does not feel the slightest shame in asking for explanations of the most trifling difficulties which he, with a very little application, could easily master.

Secondly, Bengali students have to prepare in the subjects which they read for examinations approximating to an honor standard. The geometrical conceptions involved in questions which they are consequently obliged to get up, are too difficult for the ordinary run of pass students, the majority of whom, whether in India or in Europe, have not sufficient taste for any one given subject (no matter how clever they may be at others) to take that interest in it which is necessary for the acquiring of complex conceptions. This is fully recognized in European Universities. As far as I am aware, questions requiring the conception of an "ellipse projecting into a circle," and such like, are not set for pass examinations.

The questions set in the Calcutta University approximate more and more, nearly every year, to the style of honor questions. The great difficulty in preparing students in Mathematics for these examinations is that one has to deal, not only with the ten per cent., or thereabouts, who find no special difficulty in arriving at the geometrical conceptions involved, and do not require instruction in drawing to assist them, but also with the other ninety per cent., with whom it is all up-hill work, and who must be crammed if they are to answer such questions at all. A great number of the ninety per cent. are undoubtedly intelligent enough, and would probably shine in more congenial studies. The endeavour "to facilitate their conceptions relating to space" (when these conceptions are such as cannot be grasped without special difficulty) by instruction in drawing or any other means, leads only to cramming them with extraneous ideas which can never produce fruitful results.

Geometrical drawing would, I think, be excellent optional subject for the Entrance Examination if it could be introduced into the schools. Those who might have a taste for it could profitably employ some of the spare time which *they are said to have* at present. Plotting a survey made with the chain, would be a useful occupation for those boys who hope, after passing their Entrance Examination, to obtain employment in the subordinate executive service.

I doubt, however, if the spare time of those who look forward to a University career would not be better employed in improving their English, or in reading some of the more advanced course of mathematics required for the First Arts. I have never met, in my five years' experience, an entrance student who had read more mathematics than was absolutely required for his examination.

2. I think the introduction of the VI. Book of Euclid into the Entrance Course, at present, would have a most pernicious effect. Until there is a very decided improvement in the method of teaching geometry in the schools, it would be advantageous to strike out the VI. Book; in fact, to reduce the geometry for entrance to a minimum instead of adding to it. There is no subject which suffers more from cramming than geometry. The present system seems to be to induce students, by continual practice in writing out, to retain in their memories the exact words, diagrams and letters of their text-book. At all events, very few students carry away with them from the schools an intelligent knowledge of geometrical facts, or an intelligent comprehension of geometrical methods. They are, as a general rule, quite unable to work a simple numerical example, or to solve for themselves the simplest questions immediately deducible from book propositions. They cannot even recognize a book proposition when the enunciation is changed. This is not owing to a want of geometrical taste or to dulness in understanding the book propositions. Geometry is one of their strongest subjects. It is because the system teaches them that the great and only end to be obtained is to be able to transcribe

from memory a certain number of pages of Todhunter's Euclid; accordingly they get it up, and learn it by heart (without caring in the least what it is all about), with an appreciation almost equal to that which they display in cramming the published notes on their English text-books. The geometrical facts proved in the propositions which ought to be clearly comprehended in all their hearings and retained in the memory for future applications, seem to be very seldom grasped at all. The facts which ought to be remembered, if they were ever acquired, are carefully forgotten. The needlessly elaborated proofs and old-fashioned enunciations of Euclid are retained without the slightest change to be disgorged on the day of examination with all that sickening fulness of detail in which they so much delight.

The introduction of the VI. Book of Euclid, in the present state of things, would merely foster the system of cramming; it would be prepared like the other without improving in any way the geometrical notions of the students.

3. In making alterations in the Entrance Examinations, some allowance, I think, should be made for the large class of students who do not pursue their studies further, and for whom the Entrance Course is the ultimate standard of education. The consideration of their wants should have some weight in determining changes, and this alone would be a strong reason in favour of the introduction of a short and elementary course of physical science into the Entrance Examination. I am afraid, however, that the enormous outlay which would be required for carrying out, in its entirety, the scheme proposed by the Committee, to say nothing of the difficulty of providing competent teachers, must be fatal to its adoption, whatever its intrinsic merits may be.

I think, however, that, even if it were possible, it is premature to adopt such an elaborate scheme in schools which prepare for a University in which physical science is still in its infancy. The difficulty of obtaining competent teachers would be very great. I am afraid a couple of month's training even under the able superintendence of Mr. Woodrow, would, considering the perfectly raw material (as far as physical science is concerned) on which he would have to work, hardly be sufficient to ensure such competency as to guarantee that the whole scheme would not become in their hands a mere play-thing.

In the cause, and for the honor, of physical science, I would strongly urge that rather than incur the probability of an ignominious failure, a more moderate plan be first tried which could afterwards be enlarged when thought necessary. I would suggest that a portion of the excellent Course of Elementary Chemistry (Appendix C. of Report), which it is proposed to introduce into the F. A., would be less expensive and more practicable for the schools. If to this were added either the section of Appendix A. on Statics, or, if it be thought better, the section on Heat, it would be quite as much as could be well managed, at least for the present.

4. The possibility of introducing the study of Physical Geography in the F. A. Course depends on the adoption of the box-scheme in the schools, as students without some previous training in a wide course of Physical Science could hardly be expected to derive much advantage from the study of Physical Geography. It might be put into the B. A. Examination as an optional subject with Zoology. I do not think either of these subjects should be made compulsory.

5. The course of Botany is very considerably made optional. The fears of the Committee regarding the expense and difficulty which would be incurred in providing proper specimens for the examinees are, I think, almost entirely unfounded. Very few would choose the course. The "acute Bengali" has not much taste for such scientific accomplishments. He would, however, have quite sufficient acumen to see that it would be more to his advantage to select the other optional subject—Chemistry—which would afterwards be of use to him for his B. A. Examination.

6. Considering the very limited amount of educational energy which is disposable, whether in the Mofussil Government Colleges or in the Missionary Colleges, I think it would be quite impossible, without great detriment to other

subjects, to introduce the study of Natural and Physical Science in the F. A. Course.

It would, however, even with the existing staffs, be possible to introduce the general study of the present optional course of Physical Science for the B. A., if Metaphysics were struck out of the F. A., and Geometrical Conic Sections out of the B. A. Examination.

7. I think the present lengthy course of Conic Sections might be curtailed without much loss. It does not seem to lead up to anything, and for its own sake is not of much value. The definitions, constructions, and about half a dozen propositions (which would comprise everything requisite in the applications which B. A. candidates have to make) might be included with the Geometry for the F. A.

8. If Metaphysics were not required in the F. A. Examination, the Dynamics of the B. A. Course might be substituted. These reductions would allow the present optional course in Physical Science to be made compulsory.

Optics might be made compulsory. But I would strongly urge that it should be treated in a more practical and experimental manner, and less as a medium for the solution of mere algebraical and geometrical puzzles. An elementary knowledge of the principles of spectrum analysis should be required.

9. If, however, the Sydicate contemplate at present the introduction of a thorough and practical course of study in science, one which would have a fair chance of leading to fruitful results, I would respectfully submit that very considerable modifications must be introduced into the present system of study in the University.

The great number of subjects, and the high standard required in all, render cramming in some subjects, in the case of the great majority of students, unavoidable. I entirely agree with the writer in the *Indian Observer* of August 12th, "that different men have different intellectual tastes; that within certain limits they should be allowed to indulge them." Until this fact is recognized and acted upon it will be impossible to eliminate cram, and we cannot hope for fruitful results from the study of Natural and Physical Science, or of any other subject.

10. I beg to submit, for consideration, the rough outline of a scheme which would allow of the introduction of a thorough course of scientific study for the B. A. Examination, and I think would have the more important effect of reducing cram.

The questions should be much easier than those which are now usually put. But they should be constructed with the special object of preventing candidates from passing merely by the aid of cram. No questions approximating in style to honor questions should be asked.

ENTRANCE EXAMINATION.

- | | |
|---------------|--|
| I.—LANGUAGES. | As at present. No text-books to be appointed in English. |
| II.—HISTORY. | As at present. With Geography, Elementary Astronomical facts about the Solar system. |
| III.—SCIENCE. | <p><i>Arithmetic</i>.—As at present.</p> <p><i>Algebra</i>.—As at present.</p> <p><i>Geometry and Elementary Mensuration</i>.—Geometry as in the first four Books of Euclid (or, if possible, a modern text-book) with very easy deductions and numerical examples. The use of the surveying chain.</p> <p><i>Chemistry</i>.—A short course selected from Appendix C. of the report.</p> <p><i>Statics</i>.—As in the section on Statics, Appendix A. of the report.</p> |

I do not think more than 25 per cent., if so much, should be required for a pass in any subject, except English.

FIRST ARTS EXAMINATION.

At the First Arts Examination, candidates should be examined in two distinct courses, headed (I.) Languages and History, (II.) Science.

Candidates should obtain at least 35 per cent. of full marks in one of these courses, it matters not which, and at least 20 per cent. in the other.

I.—LANGUAGES AND HISTORY.—As at present. Half the total number of marks given in English to be allowed for a critical knowledge of text-books.

II.—SCIENCE. *Arithmetic*.—As at present.

Algebra.—As at present.

Trigonometry.—As at present.

Geometry.—In addition to the present course. Definitions and construction of conic sections. The Geometry of great circles of a sphere.

Dynamics.—Kinematics, Dynamical Laws, Statics, Kinetics, Energetics, according to the present standard.

B. A. EXAMINATION.

At the B. A. Examination candidates should be examined in one or other of two distinct courses, headed (I.) Languages, History, and Metaphysics; (II.) Science.

Students should be allowed to select either of these courses, subject to the condition of their having obtained at the F. A. Examination at least 35 per cent. of the full number of marks awarded in the course which *they determine upon* selecting.

I.—LANGUAGES, HISTORY, AND METAPHYSICS.

II.—SCIENCE. *Hydrostatics*.—As at present.

Astronomy.—As at present.

Optics.—In addition to the present optional course, an elementary knowledge of the principles of spectrum analysis.

Chemistry.—As in the present optional course.

Experimental Physics.—As in the present optional course, with the addition of sound.

Inductive Logic.—A course selected from Bain.

One of the following subjects to be selected by the candidate himself :

(a.)—Comparative Physiology.

(b.)—Botany.

(c.)—Physical Geography of India (Blanford's).

(d.)—Meteorology (Bachan's).

(e.)

(f.)

Dated Agra, the 22nd August 1871.

From E. R. WATTS, Esq., M. A., PH. D., Principal, Victoria College, to the Registrar of the Calcutta University.

BEING requested to submit my opinion on the scheme suggested by the Committee appointed by the Syndicate to report on the best mode of introducing the study of Natural and Physical Science into schools and colleges in India, I beg to remark, *first*, that the course of science intended for the Entrance cannot be introduced *in addition* to the subjects of that examination. We teach Entrance candidates for five hours a day,—giving one hour for the English course, one hour for English Grammar and Composition, one hour for the second language, one hour for History and Geography, and one hour for Mathematics. Thus the whole day is spent in teaching the Entrance subjects, and it takes us full two years to get through the whole. Unless we reduce or exclude one of the subjects, we cannot introduce anything of Physical Science.

In the curriculum I submitted a month ago, I suggested the reduction of History and the substitution of a course of Natural and Physical Science as in Chambers's Introduction to the Sciences. I again recommend my suggestion, and I beg to say that there are no difficulties to be met in teaching this course of science.

I strongly object to the VI. Book of Euclid being added to the Mathematics of the Entrance Examination. The mathematical knowledge required in the Entrance is already too high. The questions on Heat, Magnetism, Voltaic Electricity, and Electro-magnetism, recommended by the Committee for the Entrance Examination, I would reserve for the First Arts, instead of Astronomy, Meteorology, Geology, and Physical Geography, in my curriculum.

As for Drawing, we have always done without it, and we can still do without it. If it is an auxiliary to the teaching of *certain* sciences, this only proves that it is of no use to a candidate who selects any *other* science. Let those who require a knowledge of it, learn it, but we should not compel *all* candidates.

Logic and Philosophy should not be removed to the optional list. In my humble opinion some knowledge of every science should be compulsory.

Dated Benares, the 23rd August 1871.

From Rev. M. A. SHERRING, Principal of the London Mission High School, Benares, to the Registrar of the Calcutta University.

I WISH to make a few observations on the report of the Committee appointed by the Syndicate on the best mode of introducing the study of Natural and Physical Science into schools and colleges in India.

2. Although it may be, and probably is, correct that students in the colleges and schools of Calcutta find their time not sufficiently occupied in preparing for the Entrance Examination, yet I hardly think this is true of colleges and schools in the North-Western Provinces. The subjects for examination should be prepared with a view to the condition of all the affiliated institutions, and not of the most favored and prosperous.

3. Admitting the importance of introducing certain physical subjects into the Entrance Examination, I would propose that they be substituted for some other subject. I would suggest that this subject be that of languages, a portion of the time devoted to which might with advantage be appropriated to the subjects in question.

4. The list of subjects in Appendix A. is excellent, but errs, in my judgment, by excess. I would propose to retain Statics, Hydrostatics, and Pneumatics, and to omit the rest. I would suggest the addition of a few simple questions on Astronomy, *e. g.*, the causes of eclipses, a subject on which almost every Hindu in these parts is profoundly ignorant.

5. It will be a difficult matter to alter with effect the curriculum for the First Arts Examination. Drawing, however, is of great utility, and should be introduced if possible. Physical Geography also is very useful, but to substitute that, or Botany, or Chemistry, for Mental and Moral Philosophy, is a singular proposition.

6. I fail to see the reason of the great prominence given to Botany. I should much prefer Geology as a subject of examination.

I am glad to find that there is a prospect of greater attention being paid by the Calcutta University to the Physical Sciences, a subject of immense importance in this country. In Benares, a general desire exists among educated Natives that the defectiveness of their education in this respect may be removed. Indeed, there has been much discussion in this city lately as to the great desirableness of measures being taken for communicating scientific knowledge of a practical and popular character to the masses of the people.

No. 524, dated the 23rd August 1871.

From Pundit MAHESA CHANDRA NYAYARATNA, Officiating Principal, Sanskrit College, to J. SUTCLIFFE, Esq., M. A., Registrar, Calcutta University.

WITH reference to the copy of a report drawn up by the Committee appointed by the Syndicate to report on the best mode of introducing the study of the Physical and Natural Sciences into schools and colleges in India, forwarded by you on the 9th instant for an expression of my opinion on the subject, I have the honor to express my dissent from some of the views and suggestions contained in the Committee's scheme.

To begin with the schools : In the first place the Committee seem to make too light of the difficulties attending the introduction of the sciences into the numerous schools which teach up to the Entrance Standard. It is proposed to give one or two months' training at Calcutta to the head or second master of each zillah school, but this would scarcely be practicable, considering the fact that the jurisdiction of the Calcutta University extends from Peshawur to Chittagong. If the proposal, as it seems, be confined to the Lower Provinces, even then the teaching would, as the Committee admit, be insufficient. It is further proposed, therefore, to supplement this teaching with a deputation of trained teachers to the principal schools—how the inferior sorts of schools are to fare it is not said—for instructing both the teachers and the pupils in the experimental part of the science teaching. Trained teachers in sufficient numbers it would be extremely difficult to get, and the Committee indeed recognise this difficulty in proposing that only the *principal* schools should receive visits from such teachers.

In the case, again, of the aided schools, on the Committee's own showing, there is every likelihood of some cram-book taking the place of that practical teaching which is aimed at. This is a tremendous difficulty, and, with all deference for the Committee's opinion, I do not see on what grounds they rest their hope and belief that the supersession of practical teaching by cram "will never be more than partial." It is a well known fact that cram reigns in the teaching of English and some other subjects of the existing University Course, and it would really be lamentable if cram was to establish its rule over *science* also. Extremely desirable, therefore, though it be to impart a knowledge of science to the rising generation of this country, I am strongly of opinion that science should not be made a subject of the Entrance Examination till a scheme could be put into operation which would make the teaching of the subject more completely practical than the one proposed by the Committee would be likely to make.

I would strongly deprecate also the addition of the VI. Book of Euclid to the Mathematics Course of the Entrance Examination.

This addition is proposed as a preparation for Practical Geometry. The Committee think again "that the present course is insufficient to occupy many of the candidates up to the age of admission to the examination." My own experience, corroborated as it is by that of several experienced head masters of schools, would lead me, however, to think that, as regards the majority of the pupils, the present subjects are rather too heavy than too light. A few remarkably sharp lads may, indeed, learn more within the time prescribed, but the majority of students find the present course a rather heavy burden. In proof of what I say I would point to the fact that candidates at the Entrance Examination of

the age of sixteen or a few months over sixteen are greatly outnumbered by those who are seventeen and upwards. It seems to me desirable, therefore, to strike out portions of certain subjects, for instance, the History of England, from the existing course, when science becomes an integral part of it.

With regard to the introduction of the Physical and Natural Sciences into the First Arts and Degree Examinations, the Committee propose two alternatives—"The first is to make all the subjects (except English) which are now compulsory, as well as the present optional subjects, *optional but not alternative subjects*." This appears to me both on theoretical and practical grounds preferable to the other alternative, *viz.*, "to make these sciences compulsory and to remove one or more of the present obligatory subjects, for instance Mental and Moral Science, to the optional list." A free option to choose the subjects in which a candidate is to be examined would afford the widest scope for special likings and aptitudes. Again, making the sciences optional will have the effect of allowing missionary and other colleges, not at present provided with Professors of these subjects, time to supply the want, and will thus save these institutions from great immediate embarrassment. To encourage the spread of scientific knowledge, and to prevent the option between science and other subjects degenerating into a mere option in name, I would humbly suggest that science be made to bear about 33 per cent. more marks than any other subject—a preference fully deserved, I think, by the intrinsic value of the subject. The rejection of all papers which do not attain a certain high percentage of marks would appear to be a surer and simpler method of preventing superficiality than the practice of deduction that prevails in the Civil Service Examination.

With regard to the science subjects included in the Committee's scheme, I have also something to say, and I say this with considerable diffidence, for here I shall have to set myself, in matters of science, against the high authority of the gentlemen who formed the Committee. The omission of frictional electricity seems to rest on insufficient grounds. Any physical disadvantages under which the Lower Provinces may labor should not in fairness be allowed to affect the completeness of a course which is intended for pupils all over the Bengal Presidency. Rather than the scheme should be incomplete, and the students of the North-Western Provinces and the Punjab suffer, in order that things may be made quite smooth for Bengal, I think that the subject should be taught in Bengal when the season is most favorable.

Again, two most important branches of Biological Science—Anatomy and Physiology—are omitted in the Committee's scheme. No department of knowledge can be more interesting than Animal Physiology, and none can have a closer bearing on the future happiness of the pupils. I would, therefore, humbly suggest that knowledge of Botany and Zoology be supplemented by that of Anatomy and Physiology. Should this addition be thought too burdensome for the pupils, I would even be for throwing out Drawing and Botany in order to make room for Anatomy and Physiology. Drawing, as the Committee urges, is no doubt a very useful subject, but it does not appear to me to be of such vital importance, as a preparative to scientific studies, that it should be made a necessary part of the Science Course. Many who may possess extraordinary aptitude for science may have none for Drawing. After consulting Bengali teachers of mathematics and students, I am again in a position to say that the difficulty attending the comprehension of propositions concerning lines out of one plane is not felt by many, and that in so far as it is felt it may be entirely removed by showing the pupils drawings of solid objects.

In conclusion, I beg to draw the attention of the Syndicate to the following extract from Professor Bain's *Deductive Logic* :

"For the purposes of the present day, the sciences may be classified as follow :

Page 25, paragraph 40.

I.—Logic.

II.—Mathematics.

III.—Mechanics or Mechanical Physics.

IV.—Molecular Physics.

V.—Chemistry.

VI.—Biology.

VII.—Psychology.

In every one of these there is a distinct department of phenomena; taken together, they comprehend all known phenomena; and the order indicated is the order from simple to complex, and from independent to dependent, marking the order of study and of evolution."

A science course, I would humbly add, may well be based on the Professor's classification.

No. 113, dated Agra, the 25th August 1871.

From Revd. F. SYMPHONAN, Principal, St. Peter's College, Agra, to the Registrar of the Calcutta University.

I AM in receipt of the report of the Committee appointed by the Syndicate to draw up a scheme for the introduction into schools and colleges of the study of the Physical Sciences, and readily respond to your request of expressing my opinion on the subject.

2. In taking a glance of the University Programme, one is, indeed, struck by the absence of Physical Sciences from the course of studies which candidates for the Entrance and First Arts Departments at present pursue. The deficiency in this respect is to me specially remarkable, from the fact of my having seen a different system followed at colleges and schools in France, where instruction in the demonstrative and experimental sciences is almost universally given. The knowledge communicated in this respect is of course limited, so as to suit the capacity of children; but a familiarity with the Physical Sciences being thus early created, the interest excited by it in the youthful mind is eminently calculated not only to facilitate the prosecution of their study in maturer years, but positively to render it a source of pleasure.

3. From the remarks just made it will be at once perceived that I entirely coincide with the opinions set forth by the Committee in the report under review.

4. So far as private institutions, and those that are receiving grants-in-aid from Government, are concerned, the adoption of the proposed measure will be attended with considerable difficulty. The resources of these institutions are doubtless severely taxed already, and unless Government should come to their help, the expenditure necessary for procuring suitable apparatuses will prove a serious obstacle to the adoption of the scheme. So far, however, as Government colleges and schools are concerned,—expenditure being a secondary consideration,—I am of opinion that the adoption of the scheme in its present form is thoroughly practicable.

5. The remarks of the Committee with respect to drawing are happily stated. Although not a branch of Philosophy, being closely allied to all arts, and entering into the course of a liberal education given at home, its introduction into schools and colleges in India is greatly to be desired. The natives of India are sadly deficient in this branch of education; for, whereas the commonest English or French journals, magazines, &c., are profusely illustrated with wood-cuts thrown off at a heat, we have no such thing as an Oriental paper or book illustrated by Native Artists according to correct principles of perspective representation. Such illustrated books as have come under my observation are surprisingly deficient in this particular. The illustrations bear a close resemblance to the attempted perspective representations we commonly see in Chinese work-boxes. In the North-Western Provinces the

Natives are not void of all talent. The artists of Delhi are excellent imitators of European works of art; but from their inability to produce anything original, it would appear that their training in the elementary branches of drawing and painting is exceedingly defective. India is not in such a forward state as to warrant the establishment of schools of design throughout the country, but the elementary instruction which the Committee propose to introduce into all colleges and schools will in a few years correct the taste of the Natives, and lead them to appreciate the beauties of European Art in statuary, painting, &c., by applying in each case the principles of drawing and design taught them in the lecture-room. I would recommend that the elementary drawing proposed in the scheme for the F. A. Course be commenced with in the Entrance, and I would also have the attention of the students directed to some good elementary work in perspective, and also to drawing from models of solid bodies. For these Provinces it would be exceedingly difficult to procure drawing-masters. One means by which this end might be attained would be by holding out sufficient inducement to the young men studying this particular branch in the Roorkee College to accept situations as drawing-masters, since the generality of professors and teachers in the different colleges and schools in the North-Western Provinces do not profess to teach drawing or perspective.

6. For the Entrance Course I would not advocate the introduction of the VI. Book of Euclid, but confine the course as at present to the first four books.

7. With respect to the introduction of Botany in the First Arts Course, I am of opinion that considerable difficulty will be experienced in carrying out the scheme in its practical bearing. The first difficulty would be the procuring of plants for illustration; also the heat of the summer is so intense in these parts that plants are scorched by the burning sun. Secondly, the flora of India is so varied and extensive, and that of one particular district or province so distinct from that of another, that unless particular genera, species, &c., are specified, the students will obtain just such a smattering of the subject as can by a little mental effort be acquired from books on Botany, and the great object the Syndicate have in view will consequently be frustrated. I would therefore confine the study of Botany to such plants as are common to all provinces in India, and would have a text-book drawn up only describing the plants selected for the examinations.

8. In the F. A. course some subjects must be abandoned to make room for those proposed. Of this class is the study of Moral and Mental Science. Important as these sciences are, I would require of candidates the most elementary knowledge of this study, if it is to be retained in addition to those proposed in the appendix. If not, I would transfer Mental and Moral Science from the list of obligatory subjects to the optional.

9. The attention of candidates for the Entrance Examination could be devoted more strictly to experimental science, if the standard in classics for European scholars were somewhat lowered. With due deference to the opinion of the Syndicate, I think it too much to expect from boys of sixteen familiarity with some of the more difficult works of Cicero, as, for example, with the Treatise on "Friendship" appointed for the ensuing examination. If the reading were limited to one book of Virgil, and one book of an easy prose writer, the scheme proposed by the Committee with respect to the study of Physical Sciences could be more closely followed by the Indian lads.

10. In conclusion I may state that I shall look forward with considerable interest to the adoption by the Syndicate of the admirable scheme proposed by the Committee at as early a date as may be practicable. But as the purchase of apparatuses for Physical and Experimental Science will require a considerable outlay of money, which the greater number of aided schools will not be able to bear, the Syndicate, if they adopt the scheme suggested by the Committee, will, I hope, recommend to Government a special grant for this purpose.

*Memorandum on the Report of the Natural and Physical Science Committee,
to the Syndicate of the University of Calcutta.*

I QUITE agree with the opinion of the Committee as to the advisableness both of devising a scheme of instruction in science that shall result in the communication to the student of practical as opposed to merely theoretical or book knowledge, and of arranging the examinations for Entrance, Degrees and Honors, so that, in as far as possible, practical knowledge only shall count for marks. The chief difficulty in carrying out the object obviously lies in the scarcity at present, and especially in the more remote Districts, of finding men possessing a sufficient practical acquaintance with the subjects indicated by the Committee to qualify them to act as teachers. This is a difficulty, however, which, should the University decide to introduce science into its schools and colleges, will not likely ever be so great in future as it is at present; for as soon as a demand becomes established for qualified teachers of science, the emoluments accompanying such appointments will in all probability form a sufficient attraction to induce undergraduates to qualify for them, and in a secondary way the object of the Committee—the spread of a knowledge of Science—will thus be encouraged. I do not think it would be advisable to defer the introduction of the Committee's scheme until a band of fully qualified science teachers should be ready to undertake the work of instruction, and to carry it on in the efficient way which one would hope one day to see. It would be better to begin at once with the men available, to make the course of instruction at first very elementary, and to pitch the standards of examination low, and afterwards gradually to raise the quality of both as a more efficient instructive staff becomes obtainable.

As regards the teaching of Botany. There is, I believe, stationed in most of the places where a school or college exists, a licentiate or graduate in medicine of the Calcutta University who, during his course of study at the Medical College, must have attended two courses of lectures on Botany, and who at the time of his passing his degree examinations—whatever may be the amount of his rustiness now—must have possessed as large a knowledge of the science as is likely to be expected of a student at the Entrance or First Arts Examinations, and who, by the prospect of a little pay, might be induced to rub up his knowledge so as to be able to teach Botany in the District School. Systematic Botany is the part of the subject about the teaching of which the greatest difficulty would be found, and I would suggest that for the first year or two it be entirely omitted from the examination papers. This would involve the exclusion of such questions as No. 5 of Appendix B. of the Committee's Report. If confined to the Anatomy and Physiology of flowering plants, the science is an extremely easy one; and, as far as Anatomy goes, it presents facilities for practical study by Natives such as no other science does, for flowers are available everywhere, and the dissection of them offends nobody's prejudices. In this way the present difficulty, as regards the teaching of one of the subjects suggested by the Committee, might be met, and there is, I think, but little doubt that (the Committee's scheme once adopted) men would, while undergraduates, devote particular attention to certain subjects in the hope of one day becoming teachers of them.

With regard to the question raised by the Committee as to the place science should hold in the Arts Degree Examinations, I would venture to say that, while desirous to see it made compulsory, I could not but regret its being made so at the expense of such important subjects as Mental and Moral Science. If the standard of examination in science be kept pretty low in all the examinations, *except in those for Honors*, I would suggest that science be made compulsory without the exclusion of any subject now in that category.

Drawing, involving as it does almost no mental strain, could not be considered much of an extra tax on students, and ought, I think, most decidedly to be made compulsory. I quite agree with the remarks of the Committee on its practical value in calling into play the faculty of observation; and in this respect it undoubtedly contributes to the formation of accurate mental habits, besides being in itself a useful and elegant accomplishment.

BOTANICAL GARDEN; }
The 25th August 1871. }

G. KING.

Dated Simla, the 26th August 1871.

From Rev. S. SLATER, Head Master, Bishop Cotton School, to J. SUTCLIFFE, Esq., M. A.,
Registrar of the Calcutta University.

I BEG to send you the following brief remarks on the scheme of the Committee for introducing the study of Physical Science into schools in India :

1. I have no doubt at all that it would be a good thing to have Physical Science taught in schools, and I also agree with the Committee in thinking that it should be taught partly by book and partly by experiment.

2. Not having access to the apparatus by which it is proposed to teach it, I cannot of course pronounce any opinion as to its suitability. I should, however, be inclined to think, from the character and range of the subjects mentioned in Appendix A., and also from the fact that the Committee doubt whether a teacher would be able to get up the subject so as to impart it to others after two months' instruction, that the course is somewhat difficult. At what age could boys *begin* it? That is the point on which I chiefly wish for information. If the study were not commenced till, say, one year or a little more before the Entrance Examination, that, I think, would only promote cramming. If Physical Science is to be made an integral part of education in this country,—and I for one should be delighted to see it in that position,—it seems to me that it ought to be carried on *pari passu* with all the other branches of instruction, beginning in the lowest classes and going regularly upwards. Will the method recommended by the Committee admit of this being done? I quite understand that this part of the subject is not strictly within the limits of the instructions given to the Committee; at least I perceive that they have aimed chiefly at showing how Physical Science may be made a *subject of examination* in Arts in the Calcutta University; but if some hints could be given for carrying out my view, I think a great boon would be conferred on Indian teachers. And, indeed, unless it can be shown that Physical Science can be taught continuously in Indian schools throughout the whole course of instruction, I apprehend that the Syndicate would not recommend that it should be made one of the subjects of the Arts Examinations.

Perhaps, however, the course of lectures about to be put forth by the London School Board, referred to in the postscript of the Committee's report, may be suitable for the purpose which I desiderate.

3. I should venture to object strongly to the addition of the VI. Book of Euclid to the Entrance Course. My experience in this school is quite opposed to that of the teachers, who affirm that "the present course is insufficient to occupy many of the candidates up to the age of admission to the examination." I should have thought that this is sufficiently disproved by the numbers who pass in the 3rd Division and who fail altogether.

4. Instead of adding to the Entrance Course, it seems to me that if Physical Science is to hold a position in examination at all commensurate with its importance, some subject in the present course must give way. I am not prepared to say, without consulting other teachers who have had experience in preparing candidates for the Entrance, what subject should be removed, but I feel confident that the present course, with the addition of the VI. Book of Euclid and Physical Science, would be too much for boys of sixteen, and would lead either to cramming or to that over-eager and excited study which, I believe, is doing a great deal of harm to young men.

5. With regard to the First Arts Examination, I quite agree with the proposal of the Committee that Physical Science should be made compulsory, and Mental and Moral Science relegated to the optional list.

Dated the 28th August 1871.

From J. W. BLOCHMANN, Esq., Head Master of the Calcutta Madrisa, to J. SUTCLIFFE, Esq., M. A.,
Registrar of the Calcutta University.

You have asked me to express an opinion on the scheme suggested by a Committee appointed by the Syndicate to report on the best mode of introducing the study of Natural and Physical Science into schools and colleges in India. I believe that the scheme in its present form will not work, because it will prove a burden on the students, notwithstanding the "fascinating" nature of the subjects recommended by the Committee.

The Committee have assumed that the present Entrance Course is too easy, and should, therefore, be increased. The increase is to consist—

- (1) in the introduction of Natural Philosophy ;
- (2) in the VI. Book of Euclid, inasmuch as it is a "preparation for Practical Geometry and Drawing."

I cannot see why the VI. Book of Euclid is required for "Practical Geometry" and Drawing, or "for the acquisition of a certain amount of artistic skill"; for, if necessary, I should say that the XI. and XII. Books would be much more contributive to the attainment of the Committee's object.

I am further quite sure that the present Entrance Course is very high, and represents a maximum standard. I have been for the last seven years teaching the course, and my experience is that the boys do not find it easy to get through it, and that the masters also have to work hard indeed to go with the boys over the present quantum. During the last five years the Syndicate has raised the standard of Mathematics and that of History by altering the subject and introducing new text-books; the study of a classical language has become all but compulsory, and the examiners have been ordered to take in all subjects the style of the boys into account. A comparison of the present examination questions with those of former years will show that there is an annual tendency to render the examination more difficult, and a mere glance at the English Entrance Course will prove that the course has become more extensive and difficult. I am not aware of "the facts before the Syndicate," to which the Committee alludes in asserting that the standard should be increased, but I believe that the amount of failures and the limited number of first division boys would rather be in accordance with my view. To quote the Madrisa as an example, six years ago we had in all classes an hour devoted to Drawing, and I myself taught Chamber's Elementary Course in Natural Philosophy in the three upper classes; but the annual increase of the University standard forced me gradually to abandon these extra subjects, necessary as they are.

I am not so sanguine as the Committee in believing that masters, capable of teaching the new subjects and exhibiting the experiments, will in so short a time spring up in the several Pergunnahs of Lower Bengal.

In conclusion, I object to that portion of the scheme which fixes the standard for Magnetism, Voltaic Electricity, and Electro-magnetism, and would recommend a course of Elementary Astronomy instead. I believe that in this country especially Astronomy is of the utmost importance, because most of the superstitions to which the natives of Bengal still cling are in some way or other connected with their Astrology, Horoscopes, influence of stars and comets on the fate of nations, individuals, &c., the removal of which, in my opinion, ought to be the primary object of our educational system. The astronomical course which has been fixed for the B. A. Examination will then be much better understood than it is at present.

Dated the 29th August 1871.

From G. THOMPSON, Esq., B. A., Head Master, High School, Saugor, to J. SUTCLIFFE, Esq., M. A.,
Registrar of the Calcutta University.

I HAVE the honor to submit the following remarks on the report of the Committee appointed by the Syndicate to report on the best mode of introducing the study of Natural and Physical Science into the schools and colleges in connection with the Calcutta University. I shall first refer to the Entrance proposals, and afterwards to the First Arts and Degree proposals.

The Committee propose to require a knowledge of the VI. Book of Euclid at the Entrance Examination as a preparation for the proposed introduction of Drawing in the higher examinations, and they also propose to introduce an extensive course of Elementary, Natural and Physical Science. It is alleged, apparently as a reason for the extensiveness of these proposals, that facts have recently been laid before the Senate by persons well qualified to form an opinion on the subject, which go to shew that the present curriculum is not sufficient to occupy boys up to the University limit of age, and that, therefore, additions may, with advantage, be made to it.

The Committee themselves acknowledge that they have exceeded their functions in proposing the introduction of Drawing in the First Arts Course and the VI. Book of Euclid in the Entrance, so that these proposals scarcely call for any remark. But, with reference to the VI. Book of Euclid, it may be mentioned that many students never pursue their studies beyond matriculation, so that the reason given for introducing it in the Entrance Course does not apply to them. And, again, students reading for the First Examination in Arts find it no easy task to master the VI. Book, and, therefore, it may be inferred that, for the majority of Entrance candidates, it would form an insurmountable difficulty. But even if it were thought desirable to introduce Drawing for the First Arts Examination, that would afford no reason for studying the VI. Book of Euclid earlier than at present; and, at any rate, the Mathematical Course for Entrance is already extensive enough, if we are to judge by the large number of failures that take place in that subject.

The facts laid before the Senate, which led the Committee to conclude that additions may, with advantage, be made to the present Entrance Course, are not generally known to the outside public, nor are the persons referred to known, who give it as their opinion that the present course is not sufficient to occupy boys up to the limit of age; and it is a pity that the grounds for the Committee's proposals are not more fully discussed in the report. It is possible that the reticence of the Committee may lead people to associate the persons referred to with those who so strongly urged the abolition of the entrance limit of age. My experience, however, does not shew that boys could overtake a larger course before the age of 16; on the contrary, the average age of entrance candidates from this school for the last few years has exceeded eighteen years, and no candidate has ever been prevented from appearing at the examination by reason of his youth. I know the case may be, and very likely is, different where English education is more advanced than in the Central Provinces; but the University curriculum should not be so framed as to be specially suitable for the more advanced pupils and schools; the case of the less advanced and younger institutions should also be fairly considered.

The appointment of a Committee to report on the introduction of Natural and Physical Science, while not binding the Senate to any particular portion of the subject, or any particular scheme or its introduction at any particular stage of the University Course, points to the introduction of the subject in some shape; but the most sanguine friends of Natural and Physical Science could scarcely expect that such an extensive course as that proposed would be added to the already difficult Entrance Course. I think it would be impossible for boys generally to master such a course; and the difficulties in finding and paying teachers, at least in all the minor private schools, and perhaps in Government schools also, and the expense for apparatus, would offer very serious obstacles to the progress of the University. But if the Natural and Physical Science Course proposed by the Committee were reduced by one-half, teachers generally would be able, with the aid proposed by the Committee, to prepare themselves for giving instruction in them; special teachers would not, as a rule, be required; the cost of apparatus, if Statics, Hydrostatics, and Pneumatics only were retained, would be reduced very considerably; and experiments in these would involve little or no waste.

I would humbly submit, therefore, that the VI. Book of Euclid be left out of the Committee's proposals, and that the Natural and Physical Science be reduced by one-half, Statics, Hydrostatics, and Pneumatics only being introduced in the Entrance Course to the extent proposed in the report.

In regard to the F. A. Examination, it is admitted on all hands that no additions can be made to the present curriculum, so that, if Natural and Physical Science is to be introduced, one at least of the present subjects must be abandoned. But if a beginning is to be made in the study of this subject for the Entrance, which, I hope, will be generally admitted to be highly desirable, it should not be dropped at that stage; the knowledge already attained should be extended and deepened as far as practicable. This, however, does not apply to Drawing. I know of no reason that would justify the introduction of that subject. It is one for which few have any taste, and its practical value to the majority of students may be doubted. Besides, no English University yet considers Drawing a necessary part of a liberal education. Not the least important objection to the introduction of Drawing is the expense that would be entailed on all institutions teaching up to the First Arts standard. However, if the study of Natural and Physical Science be not allowed to stop at the Entrance, if it be made compulsory for the F. A., some part of the present course must either be abandoned or made optional. There are many objections against abandoning Mental Philosophy, the subject which is most likely to give place to Physical Science, and it might be advisable to allow candidates still to take it up at their option; but in this case a high degree of efficiency should be reached, both in the compulsory subjects and in the optional one, before the candidate is allowed to benefit by the latter. It may be objected to making Mental Philosophy optional, that a great advantage would thus be given to colleges with a large staff of Professors, where provision could be made for tuition in that subject.

The Committee further propose to introduce Botany and Elementary Chemistry as optional subjects in the First Arts Course; but if a smaller course of Physical Science than that recommended in the report be introduced for Entrance, the compulsory introduction of the remainder at the F. A. Examination would seem to recommend itself as the most natural course. In that case Chemistry might be left, as at present, among the optional subjects for the degree, and Botany might with advantage be added to the same list. In this way Elementary Dynamics, Heat, Magnetism, and Electro-magnetism, and the Physical Geography of India, would take the place of Mental Philosophy. The course for the degree would stand as at present, except that Botany would be added to the list of optional subjects.

Such a revised curriculum as I have endeavoured to sketch would fulfil the conditions which the Committee laid down for their guidance; it would be at once practical and practicable. It would have the advantages of avoiding violent innovations, such as Drawing, and of securing a considerable practical knowledge of Physical Science from F. A. candidates by a gradual process. The energy of Entrance candidates would not be damped by the difficulties of the VIth Book of Euclid. A large expenditure for teachers and apparatus would not be necessary. The knowledge of Natural and Physical Science acquired by Entrance candidates would be improved and extended for the F. A., and the compulsory study of Drawing, a subject which would necessarily be uncongenial to a large number of students, and of questionable practical importance, would be avoided. The study of Mental Philosophy, which requires more power of thought and more accurate habits of observation than are generally possessed by F. A. students, while not debarred to the more studious and talented, would be delayed to a period when students might be expected to grapple with it more successfully than they do at present.

* Dated the 30th August 1871.

From S. LOBB, Esq., B. A., Officiating Principal of the Kishnaghur College, to J. SUTCLIFFE, Esq., M. A., Registrar of the Calcutta University.

In accordance with your request (9th August 1871), I beg to offer the Syndicate the following statement of my views with reference to the report of the Physical Science Committee :

1. As to Drawing, I can see no possible advantage that is likely to accrue from teaching it yet awhile. From an artistic point of view, such an accomplishment is altogether premature, and could produce no good results. We

should have to employ European models, and these are not suited to oriental taste. If it be urged that Drawing is needed chiefly as an auxiliary to science, I beg on this ground to enter a still more emphatic protest against its introduction. A thorough knowledge of Plane Geometry is all that is really necessary for those who do not make Mathematics a special study: such a knowledge is far more likely to be obtained when the mind is not distracted by too many subjects. An adequate conception of all the truly fundamental principles of Physical Science may be obtained without any study of either Drawing or Solid Geometry. Not more than the first four Books of Euclid ought to be expected from Entrance candidates in the way of Geometry; the VIth Book (which cannot be read without the definitions of the Vth, and without a clear notion of Proportion from the geometrical point of view) is too abstruse, and Drawing is wholly superfluous.

2. I will now point out what appears to me to be a most serious difficulty, even supposing that the scheme were otherwise an advisable one. I allude to the money difficulty. In looking over the report, I find that the expenditure will be rendered necessary in each of the following cases:—

- (I.)—For the teachers who are to be supplied to the schools and colleges by Mr. Locke (see page 4).
- (II.)—For bringing the Head or Second Master of each zillah school to Calcutta for a month or possibly more in the cold weather, in order that he may be taught by Mr. Woodrow to manipulate the scientific apparatus (see page 4).
- (III.)—For the supplementary teachers who are to visit the principal schools, and instruct both the masters and their classes in the experimental part of the science teaching (see page 4).
- (IV.)—For the qualified examiners who are to be sent to the more remote centres at which the F. A. examinations are held, in order to see that proper botanical specimens are supplied to the examiners (see page 6).
- (V.)—For the botanical specimens mentioned in the preceding paragraph (see page 6).
- (VI.)—For the boxes of scientific apparatus which are to be supplied to the schools (see pp. 5 and 6).
- (VII.)—For drawing materials. (The scheme mentions ‘copies,’ ‘flat examples,’ ‘mathematical instruments,’ all which I conclude must be purchased from our educational funds.)

I am unable to calculate the total sum that would be requisite in order to give effect to the suggestions of the Committee, but it would no doubt be a considerable one. Are we justified in incurring such an expenditure unless equivalent retrenchments can be made in other directions? The principal part of the outlay would be required for the schools, which are the very institutions where Physical Science is least wanted, and least likely to prove advantageous. I do not object to strengthening the course of science in the colleges, if it can be done without any additional expenditure, but I do most strongly object to making a costly experiment of this kind in the case of the schools where failure would be inevitable.

3. Allowing that the scheme is quite unobjectionable in itself, still we have not the instruments to work it with. Good teachers of Physical Science cannot be trained up in a couple of months, nor even in a couple of years. Then, supposing that the machinery indicated by the Committee has been put in motion, how long do they suppose it will continue to work spontaneously after the first enthusiasm has abated and the direct stimulus of European control has been removed? The difficulty of obtaining qualified teachers is, to my mind, an insuperable one. Considering that, although our educational system has been in operation for about half a century, not one in a hundred of our teachers has even a tolerably correct knowledge of the English language,

it strikes me as a peculiarly bold assertion that, for the purpose of communicating instruction in so delicate a subject as Physical Science, "there will be little difficulty in procuring teachers of the rank of Assistant Professors in the course of a year or two, even if not at present." I am confident that the Committee, if they had consulted the heads of our profession, would have found that I am not solitary in my opinion that Native teachers, as a rule, are utterly unfit to teach Physical Science, although they may frequently be well qualified for Mathematical Professorships. Their imperfect knowledge of English is alone sufficient to disqualify them from teaching a subject which requires a perfect mastery of the language in which its principles are expressed. This imperfection could not be removed by any text-book, however excellent it might be. A text-book can never supply the place of a teacher in such a subject as Physical Science. The mere knowledge of a few scientific principles does not necessarily render a mind scientific, or enable it to communicate to others the contagion, as it were, of a scientific enthusiasm.

4. *The Apparatus.*—The Committee speaks of the apparatus being kept in a workable condition. Is the Committee aware that in every Government Mofussil college there are valuable sets of apparatus which have been purchased at a considerable expense, but which, partly owing to neglect and partly to the nature of the climate, have become utterly useless? Apparatus, if it is to be provided at all, should be of the very simplest description, and the teachers should, where possible, construct their own models, or invent rough methods for illustrating the chief principles of the sciences they are concerned with: a teacher who cannot do this is not fit to discharge the duties of his office aright. Now, as to keeping the apparatus in order. This is a task which would either be neglected altogether, or would be left to some servant whose appreciation of science would most probably not be sufficiently strong to induce him to pay much attention to an irksome and unaccustomed duty. I have experienced the greatest difficulty in getting our own college apparatus put into tolerable order, and yet it is to be presumed that the staff of a Government college is more than ordinarily zealous and intelligent. If none but the very roughest instruments can be preserved intact even in the colleges, what are we to expect in zillah and minor aided schools? I believe that in these schools fresh apparatus would have to be supplied every year, perhaps oftener.

5. "With regard to the Entrance Examination, it appears, from the facts recently laid before the Senate, that some addition may be made to the present Course with advantage." Such is the opinion of the Committee, and with this opinion, in spite of the facts laid before the Senate, I respectfully beg to join issue. However small may be the quantity of learning demanded of Entrance candidates, it is notorious that none of them know their subjects well. Their English is atrocious; indeed it is not English at all. As it is with English, so it is, in a less degree, with Mathematics. Second year students may frequently be met with who have not the faintest notion of the rationale of a decimal fraction; they may be able, in an imperfect way, to add, subtract, multiply, &c., decimally, but when asked upon what principle a decimal fraction is constructed, they are completely bewildered. Surely it is quite sufficient that Entrance candidates should have a good knowledge of English, of Sanskrit, or their own vernacular, and of Mathematics, according to the present standard: if they master these subjects properly, they will have enough to tax *all* their mental energies to the utmost.

6. With regard to the schedule of subjects for the F. A. Course (as given in section 3, p. 7), I would observe that Drawing, Physical Geography, and Botany seem to me most inappropriate, and indeed quite out of place in a course of Abstract Physical Science. Would it not be better to exact from F. A. students an increased knowledge of Statics and some acquaintance with the principles of Dynamics? Many stop at the F. A. Examination. In the case of such, I confidently assert that an intelligent appreciation of the Three Laws of Motion would be of far more service than any amount of Botany and Drawing. Physical Geography is really so vague a term—it may be made to include so wide a range of subjects—that I cannot discuss its educational value. Its very vagueness, however, seems to afford a sufficient reason for excluding it from an elementary course.

7. From Appendix A. (p. 10) I find it is expected that Entrance candidates will be able to give a general description of certain experiments, and to illustrate their descriptions with good figures. Now to do this well in original terms would be an extremely difficult task even for most educated Englishmen. There are many who might thoroughly understand an experiment, who would be utterly unable to write down upon paper a clear and accurate explanation of it. The gift of scientific expression is a very rare one, and not often possessed, in any marked degree, even by savants themselves. How then can we expect a Bengali youth, writing in a foreign language, to give a good description, both written and pictorial, of an experiment which at best he can but appreciate imperfectly. But perhaps it is intended that he should commit to memory the description given in his text-book. If so, let it be explicitly stated. Such descriptions as the Committee contemplate must either be learnt by heart, or must be dispensed with altogether: it is not fair to require an Entrance candidate to describe scientific experiments in phraseology of his own; this is a task far beyond his limited powers.

8. In the course for the B. A. Degree (see p. 8), I object to Drawing and Zoology. I have before explained why Drawing should be excluded. Zoology is a concrete science, the *general* science of the laws of life being now usually termed Biology. To teach Biology thoroughly to B. A. students, either in its general form or in any of its concrete branches, would be quite out of the question. There is no officer in the Department, except among the Professors of the Medical College, who is competent to teach the subject. To teach it properly one must have had the same training as a professed physician at least, therefore it could be but an affair of text-books. I willingly admit the eminent utility of the subject, but doubt whether it can yet be taught with advantage in Indian colleges, where the Professors are all men who have received only the ordinary classical or mathematical training which is at present given to general students in the Universities of Europe. If, however, any branch of Biology should be introduced, I should be in favor of one that bears directly upon the human subject. In preference, therefore, to the Zoology of Milne Edwards, I should recommend either select portions of Mr. Lewes's "Physiology of Common Life," or Mr. "Huxley's Elementary Lessons in Physiology."

9. In conclusion, I beg to offer the Syndicate my own views in regard to the changes which it would be desirable to make in our University Course of studies:

- (I.)—*Entrance*.—I should recommend that the subjects for the Entrance Examination be not interfered with, but that greater precautions should be taken for securing a thorough knowledge of these subjects. The English especially requires to be vastly improved.
- (II.)—*F. A. Course*.—I should be in favor of striking out Reid (a book perfectly unintelligible to second year students) from the F. A. Course, and of substituting for Fowler a *very short* compendium of Logic, designed solely for the purpose of illustrating the deductive processes of Algebra and Geometry. This change having been effected, the amount of Statics might be increased and a portion of Dynamics might be read.
- (III.)—*B. A. Course*.—From the B. A. Course I would eliminate Hamilton and Fleming, introducing instead (if such reading must be retained) a course of Philosophy on the model of the Literature Course. This Course should not contain more than 250 pages, and should consist of extracts from the best philosophical writers, such as Bacon, Descartes, Leibnitz, Locke, Berkeley, Hume, &c.; it might be changed from time to time. This curtailment of the Philosophy would enable us to strengthen and increase the Physical Science already entering into the B. A. Course. My plan is as follows:
 - (a.)—*Conic Sections*.—The Conic Sections should be restricted to those conceptions which are indispensable for a right understanding of Elementary Astronomy and Physics (proper), and the subject ought not to be optional.
 - (b.)—*Dynamics*.—A portion of Dynamics having been read in the second year, this subject might enter far more largely than it now does into the B. A. Course. The Theory of Projectiles, Impact, Constrained Motion, and Centrifugal Force, might, with advantage, be added to the portions already prescribed.

(c.)—*Hydrostatics*.—The Hydrostatics also might be strengthened among the machines ; for example, the steam engine ought certainly to find a place.

(d.)—*Optics*.—This subject should be made compulsory, and the portions which are now read might be somewhat curtailed.

(e.)—*Sound, Heat, Electrology**.—Finally, it might be required that the B. A. candidate should be conversant with the most useful and familiar principles of Sound, Heat, and Electrology.

* Electrology includes Electricity, Magnetism, and Galvanism.

No abstruse Mathematical calculations should be allowed to creep into this part of the Course. It should be as untechnical and simple as possible.

10. Accompanying this is a minute which has been drawn up by Mr. W. G. Willson, M. A., at my request, and which may be of service to the Syndicate, as coming from one who is an accomplished Physicist, and who has been engaged in this country for some years in the practical work of collegiate education.

No. 1768, dated the 31st August 1871.

From C. A. R. BROWNING, Esq., M. A., Director of Public Instruction, Oudh, to J. SUTCLIFFE, Esq., M. A., Registrar of the Calcutta University.

I HAVE the honor to acknowledge the receipt of your endorsement of the 10th instant, forwarding a scheme regarding the introduction of the study of Natural and Physical Science into schools and colleges affiliated with the Calcutta University. As to the advisability of introducing the study of Physical Science there can be no doubt, for I suppose it is generally allowed that the vast strides that have been made in modern times, both by the nations of Europe and by the people of the United States in America, in material prosperity are almost entirely owing to the study of Physical Science. And not only have these nations prospered directly by such study, but indirectly the habit of mind that has been induced—the habit that refuses to accept the truth of a statement simply because it is presented with the authority of present reputation or past tradition—has been especially valuable, and has led, as pointed out by Mr. Buckle, to greater toleration in the non-essentials of conduct and theology, as well as to a mastery over those forces of nature that were formerly regarded in Europe, and are still so regarded in Asia, with superstitious reverence. The study of Physics, moreover, not only requires a verification of facts, but their due collection. It, therefore, induces a mental habit to the full as constructive of what is true, as destructive of that which is false, and is therefore peculiarly fitted for the study of Hindus at this time, when their semi-religious physical beliefs have received so many rude shocks. But though the importance of the right study of Physical Science cannot be too highly regarded, yet I fail to place the same stress as the Committee, in Physical Science teaching at least, on the knowledge of things rather than the knowledge of subjects. Of course in Natural Science I use the term to distinguish those branches of Physical Science that do not treat of the forces of nature; there is a wide demarcation between what the Committee term “book knowledge” and knowledge of a practical character. Thus, for instance, a book knowledge of Botany would be but of little use, if the student were unable to classify any common plant presented to his observation; or a book knowledge of Mineralogy would be of little use, unless the pupil could readily distinguish any ordinary mineral submitted to his inspection. But Natural Philosophy, as well as pure Mathematics, so entirely deals with the reasoning faculties and the powers of observation, whether such observation regards real objects tangibly presented, or conceived objects known to exist but not presented in any tangible shape, that there does not appear to be any great distinction between well assimilated and real knowledge, though gained by books, and knowledge conveyed by lectures. Let us take, for example, a very simple toy, named by the Committee a Cartesian diver in a glass cylinder. A student has attended, suppose, a course of lectures, and his lecturer has explained the compressibility of air and the transmission by water of pressure equally in all directions. The lecturer then shows the Cartesian diver, presses the piston or the Indian rubber top, compresses the air in the cylinder, forces water into the bulb, the floating apparatus of the diver, and by

increasing the weight in the bulb, causes the diver to sink. A lad who has attended a course of lectures is asked whether, if the air be compressed in a tube containing a Cartesian diver just floating in water, the diver will sink or rise, and is required to explain his answer. He has seen the experiment hundreds of times; he remembers to have been told that the diver sinks, because the pressure communicated to the air in the cylinder is in its turn communicated to the water of which a small portion is forced into the bulb, owing to the compression of the air in the bulb; this additional water renders the bulb heavier than before, and causes the bulb and the figure it supports to sink. Another lad has never seen the experiment, but has seen the figure, of a Cartesian diver in a book, or has never even seen such a figure. He is asked the same question, and, reasoning from the forces acting on the figure gives a correct answer, and explains why the figure sinks. The knowledge possessed by the first student is scarcely superior to that of the second. The knowledge of both may be valueless, in the one case depending on the memory of things exhibited and explanations given *vivâ voce* by the lecturer, and in the other case may hinge on the remembrance of things read; or in both instances the information may be valuable, as it may have called out the reasoning power of the students. On the latter supposition, it is likely that the intellect, as evinced by his answer, of the boy who had never seen such a figure, but explained correctly the reason of its sinking, is of a higher kind than that of the lad who reasoned from experience. He who had not seen would have added imagination to reasoning, and without imagination great attainments are as unattainable in Mathematics, whether pure or mixed, as in any other science. It is not said that, for the ordinary student, experiments are useless; but what is asserted is, that their absence should not subject any student to the taunt of having been crammed with the facts of a certain text-book, and having acquired certain facts without any power save that of memory having been called into requisition. The real mathematician, who has never seen an experiment, will certainly beat the lad who has attended a course of lectures illustrated by experiments performed with the most costly apparatus, but who is devoid of mathematical genius and ungifted with imagination. Whilst then I fully think that Natural Philosophy should be introduced as a subject of study even in the Entrance Course, yet I would leave out of consideration all boxes, whether ten or more, and would simply prescribe a text-book, taking care that the questions proposed should test a pupil's reasoning faculties and powers of actual observation or correct imagination. And for the scheme that I would humbly venture to propose, I think the text-book by Lund, as now revised and used at Cambridge by men who pass their ordinary degree, would be amply sufficient. It contains profuse examples, and mere cram with anything like judicious examiners would be simply impossible, whether the cram was administered by a lecturer with apparatus, or by a tutor with a text-book. No one by cram can prove a deduction from Euclid that he has never seen, nor can he solve a problem in Statics of which he has never heard. As a rule, I should imagine that the heads of our high schools would find it advisable to exhibit apparatus and show its use, and perhaps the University have merely to see that the knowledge gained is sound, and may leave the method of instruction to school-masters.

2. Having thus assented to the importance of instruction in Natural Philosophy, it remains to consider at what part of the Course, and to what extent the subject should be introduced. The Bombay University has from the first demanded from all students at Entrance an elementary knowledge of the mechanical powers, the laws of chemical combination, and the Solar system. In Bombay such knowledge has been found to be easily attainable, and the Calcutta University will probably not over-tax the powers of young students by requiring similar, but more precise, knowledge. And here I must say that even the most elementary investigation of statical forces can hardly be conducted without a knowledge of the VIth Book of Euclid. If, therefore, a knowledge of Statics be considered a desideratum at matriculation, a knowledge of the VIth Book of Euclid is also necessary. The course suggested by the Committee in Statics, Hydrostatics, and Pneumatics seems to be judicious, but I am humbly of opinion that Heat and Magnetism should not be added to the above subjects. It would be better that young men on entering the Calcutta

University should possess a more accurate elementary knowledge of Statics, Hydrostatics, and Pneumatics, than that they should add to a less accurate elementary knowledge of such subjects some acquaintance with the laws of Heat and Magnetism. I should say, too, that the introduction even of the Vith Book of Euclid, and of Statics and Hydrostatics, will necessitate six months' additional study, and if the other subjects be added, another year will at least be required. The door for Entrance may, moreover, always be kept a little ajar, provided the subsequent examinations are searching. The Committee do not say why they have added Heat and Magnetism to the proposed Entrance Course, though reasons are given for the omission of Dynamics. Why the study of Heat should have a preference to the study of Optics or Magnetism to Accoustics, or either to such an elementary knowledge of Astronomy as required by the Bombay University is not clear. Possibly the Committee have good and sufficient reasons for the selection ; but so far as my experience extends, I think that, for some years at least, the Entrance Course would be sufficiently difficult if only Elementary Statics, Hydrostatics, and Pneumatics were admitted, and Heat and Magnetism were excluded. Even now the pupils who pass possess but a very imperfect acquaintance with English ; and if, as it is asserted, though I have not found it to be the case in Oudh or the Central Provinces, there is not sufficient matter in the subjects of the Entrance Examination to occupy a student until he is 16 years of age, greater proficiency in English may be required.

3. For the Arts Course after Entrance, the Committee do not seem to suggest the introduction of any new compulsory subjects, but to counsel the admission of alternative subjects. Amongst such alternative subjects are Drawing, Botany, Elementary Chemistry, Phsychology and Logic ; for I presume that Phsychology and Logic will be removed to the alternative class. Thus candidates for the First Arts Examination would be required to pass in the following obligatory subjects :

- (1.)—English, and one of the following languages : Greek, Latin, Sanskrit, Hebrew, Arabic, as at present ;
- (2.)—History, according to the existing scheme ;
- (3.)—Mathematics, ditto ditto ;

and to select one of the four alternative subjects named above. The increase of the alternative subjects would give to each candidate greater latitude of choice, and would, within certain limits, give play to individual talent. There would, however, be less freedom of selection than if the Senate were to make all subjects save the language test optional but not alternative, and to adopt in the modified form the system pursued by the Punjab University College. But a large number of optional subjects would greatly embarrass teachers, render impossible the formation of classes of any size, and would be productive of very considerable expense. At present students have so few means of private instruction, and the intellectual bias of the majority is so decidedly to the study of Language rather than to Science or History, that it would, perhaps, be better to introduce the study of Physical Sciences rather by the increase of alternative than optional subjects. Although, as the Committee urge, a knowledge of Drawing is a valuable auxiliary to the study of science, yet, accepting the instance given by the Committee, the drawing of a lad who possessed so little imagination as to be unable to conceive the projection of a circle into an ellipse or a straight line, would surely be so purely mechanical that, for students of such calibre, Drawing need hardly be introduced into the curriculum. It would be better, perhaps, that they should at once commence the more active duties of life. The more gifted and imaginative students would either readily acquire sufficient manual dexterity to represent any figure that their studies required, or, even failing in such manual dexterity, would easily be able to conceive of angles and forces not in the same plane, though they could but very readily and imperfectly present such angles or forces on paper. But though I would exclude Drawing in science teaching from amongst the alternative subjects, yet I have long thought that far too little attention has hitherto been paid to the surprising aptitude that many natives of this country have for drawing and coloring. Recently it

was my duty to prepare subjects for the International Exhibition at Kensington, and the spirited drawing sent up by self-taught men and pupils forced me to the conclusion that there was a great amount of indigenous art talent that, to be valuable, required but development. The modellers at Lucknow are already famous. In every college there might be a Drawing Master. But attendance at his lectures need not be compulsory but optional, and a body might be formed at each of the Presidency cities, who might have the power of conferring degrees for Drawing, Sculpture, Modelling, and Painting. At Cambridge Musical Bachelors are tolerated, and there does not seem any *à priori* reason why there should not be Art Bachelors. But I would not confound proficiency in art with proficiency in science by requiring a knowledge of drawing from science students. By such confusion, there would be the risk, nay the certainty, of bad art, and science papers imperfectly reasoned, but remarkable for their neatness of execution and their wooden correctness of drawing of philosophical instruments or scientific diagrams. I suppose that most examiners would prefer to reserve a correct and thorough explanation of an hydraulic press, however rude the figure might be, to a less complete explanation with a figure in excellent perspective. The University then might lay down a course of study and practice for Art Bachelors, and might encourage science students to acquire some knowledge of perspective and a little manual dexterity in drawing; but I am humbly of opinion that, for science students, there should be no examination in Drawing, nor should a knowledge of Drawing be at all considered in a science paper.

4. Zoology, Geology, and Physical Geography are already included amongst the alternative subjects, one of which is to be selected by a candidate for his degree. I do not know then that I would select the Physical Geography of India, and attach to it a knowledge of Botany or Elementary Chemistry, as recommended by the Committee, for the First Arts Examination. The vegetation of a country is certainly a portion of its Physical Geography, but Physical Geography and Chemistry are not at all allied. Would it not be better to make Physical Geography itself an alternative subject in the First Arts Examination, and separate its study entirely from the Botany and Chemistry of that Course and from the Geography of the B. A. Examination?

5. I append to this letter the changes that might, perhaps, be introduced into the existing Arts Course.

A.

Additional subjects proposed for the Entrance Examination of the Calcutta University.

(1.)—The VIth Book of Euclid.

(2.)—*Mechanics*.—I.—The composition and resolution of forces.

II.—Simple machines. Ratio of the power to the weight in equilibrium.

III.—Centre of gravity of a plane surface, a pyramid, a cone, and a cylinder. Stable, unstable, and neutral equilibrium.

Hydrostatics and Pneumatics.—I.—Definition of a fluid, a liquid, and a gas.

II.—The surface of a fluid at rest is a horizontal plane.

III.—Pressure of liquids.

IV.—Specific gravity, hydrometer, hydrostatic balance, &c.

V.—The Barometer, common pump, forcing pump, air-pump, siphon, fountain level, and ordinary philosophical toys and apparatus.

The text-book recommended is the Cambridge Course of Elementary Natural Philosophy, revised and enlarged by Thomas Lund.

B.*Alternative subjects for the F. A. Examination.***(1.)—Psychology and Logic.**

Reid's Enquiry, or Abercrombie on the Intellectual Powers.

Deductive Logic—Fowler.

(2.)—Botany as recommended by the Committee.**(3.)—(I.)—Accoustics, as in Professor Tyndal's Lectures on Sound.****(II.)—Airy's Optics.****(4.)—Chemistry as recommended by the Committee, including that knowledge of Heat, Magnetism and Electricity proposed by the Committee for the Entrance Examination.****(5.)—Physical Geography, as in Mrs. Somerville.****C.***Changes for the B. A. Examination.*

No change is proposed in the present Course, save the omission of the study of Physical Geography with Geology, which is itself a branch only of that subject. The student who intended to select Geology as his alternative subject for the Degree Examination might be required to select Physical Geography as his alternative subject for the First Arts Course.

MEMORANDUM.

IN February last, I addressed a letter to the Syndicate suggesting (1) that some knowledge of the rudimentary principles of Natural and Physical Science should be required from Entrance candidates; and (2) that a higher standard should be laid down for candidates of the First Examination in Arts. A Committee was thereupon appointed to report on the best mode of introducing the study of Natural and Physical Science into schools and colleges in India. As the report of that body is now before the Syndicate, I take this opportunity to offer some remarks which I hope may prove of use in the consideration of the important question. As the Committee has not referred to the specific suggestions contained in my letter, I shall confine my remarks to its report.

2. For the Entrance Examination the Committee recommends (1) the VIth Book of Euclid, and (2) answers to a schedule of questions on a set of boxes of apparatus illustrating Experimental Statics, Hydraulics, Pneumatics, Heat, Magnetism, and Electro-magnetism.

3. The reason assigned for the first recommendation is that "the VIth Book of Euclid forms a fitting preparation for Practical Geometry." At the head of the schedule it has, however, been laid down that "in the answers of students to questions set out of this schedule of Experimental Science no mathematical calculation will be required: what is wanted is a general description of the experiment illustrated with a good figure." The necessity for the VIth Book of Euclid is consequently done away with, and I see no reason for insisting upon its study before entrance. The London University, on the model of which the Calcutta institution is founded, requires no more than four Books of Euclid; the Oxford and Cambridge Universities are, I believe, likewise satisfied with that amount of Geometry; and there is nothing in India that would render a higher standard either necessary or expedient. On the contrary, looking to the returns published in the minutes of the Calcutta University, I find that the natives are less able to master the subject than

English youths. Thus of failures in mathematics there were, in the Calcutta University—

In 1867-68 ...	...	308	out of a total of 671
„ 1868-69 ...	...	549	„ „ 795
„ 1869-70 ...	...	631	„ „ 875
„ 1870-71 ...	...	421	„ „ 765
Total ...		1,909	out of a total of 3,106

giving an average of 61·46 per cent., while at the two examinations at the London University in 1870 there were 213 failures in that subject out of a total of 407, or a fraction over 50 per cent. These figures clearly show that we should be, if any thing, less exacting in India on the subject than in England. But it is the furthest from my wish to make any exception in favor of the youths of this country. If they are to have their qualifications measured by an English standard, they should be obliged to come up to it in every respect, and should have no favor shown them. But at the same time it would be positively unfair and unjust to exact more from them than from others.

4. The practical result of the proposed measure would be to increase the number of rejections; to render nugatory the efforts of a great number of our preparatory schools; and to offer a serious obstacle to the present healthy progress of education in this country. Indeed, if the object of the Committee had been to circumscribe the sphere of action of our colleges, and not to render them more widely useful, as doubtless it is, it could not have hit upon a more effectual scheme.

5. I shall not deny that the question of learning a particular Book of Euclid before or after entrance is not of much consequence to the students, but to a great number of aided and other schools in the country it will be of the utmost importance, and the very existence of some of them may be jeopardized. I cannot, therefore, I regret, give my assent to it. A sound elementary education without a small modicum of Physical Science for a large number of persons is infinitely better than the same with it for a small number.

6. The schedule of questions, taken as a course of Natural and Physical Science, is avowedly “fragmentary and unsymmetrical,” but it has been adopted, says the Committee, with a view to bring the objective character of the sciences, “and to involve teaching of a *practical* character,” so as “to inculcate a knowledge of things in contradistinction to mere book knowledge.” This object is, doubtless, a good one. The “canker of epitomes” is in some departments becoming a nuisance, and every effort to repress it should be duly encouraged. But I feel disposed to doubt that the object is likely to be easily, or at all, attained by the sacrifice of symmetry and the natural sequence of science. It also should be borne in mind that elementary education cannot be carried on without epitomes and primers, and that there is a great deal of memorial matter which must, and cannot but, be learnt from books, and without which no experimental knowledge can be of any avail. To prove this, I must examine a few of the questions suggested. The first is “the parallelogram of forces”; the second “a body supported at a fixed point and acted on by forces in one plane will remain at rest if the moments of the forces about the point balance one another.” The third “to find by means of a scale and protractor the resultant of forces acting on a point.” To explain these, a student must have a knowledge of the general properties of matter and motion, and this must be learnt either from a primer, or from notes of lectures which are to serve the purposes of a primer. The fourth question requires the student “to find the relation of the power to the weight in levers, pulleys, wheel and axle, the inclined plane, and the screw; and to be able to do so he must first know what those instruments are, the principles on which they act, their different varieties, and the laws which regulate their action, singly or in combination. The other questions recommended require, in the same way, some elementary

knowledge of first principles, and these must be learnt from primers or notes of extempore lectures. Even for the teaching of the uses of philosophical instruments, the Committee has found it necessary to recommend a "book of directions" to be prepared by Mr. Woodrow, and it would be idle to suppose that those who will be driven to the necessity of having recourse to this guide to handle a set of model levers, or a pump, or a pop-gun, will do otherwise than repeat some popular primer or other by way of a lecture. When a student in the Medical College, I myself, for some time, used to take notes of lectures, but finding some of them looked so very like pages of "the Dublin Dissector" slightly mutilated, that I dropped the practice, and bought a copy of that work. That every student in the country will be placed in my position by the side of idle or inefficient teachers of Physical Science, I have no reason to doubt, and nothing that the Committee has suggested, or can suggest, will prevent it.

7. It being thus utterly impossible to avoid the use of primers, and a certain amount of book knowledge or memorial matter being absolutely necessary for beginners, it would be infinitely better for the Syndicate, or the Faculty of Arts, to select suitable books, and secure uniformity, than to leave the choice of books to the teachers, or, by a vain desire to secure oral teaching, pure and simple, oblige the students to depend upon imperfect notes of what cannot but generally be defective lectures.

8. The subjects selected appear to me a great deal too comprehensive. Voltaic Electricity and Electro-magnetism, including the properties of induced and secondary currents, the construction of electro-magnetic coil machines and the like, are too intricate and difficult for an elementary course. They are not required at the London University, and should be dispensed with, or relegated to the F. A. Course.

9. I am of opinion, further, that the scheme proposed is not practicable. The number of instruments suggested, including air-pumps, barometers, induction machines, and a great variety of other apparatus, are inaccessible in this country, and cannot be got out from Europe except at a cost which will be prohibitory. From the prices marked on the instruments and apparatus to be seen at the Office of the Director of Public Instruction, I calculate the total cost roughly at Rupees 500. At that rate a sum of Rupees 5,14,500 will be required to provide for the 719 colleges and schools* in Bengal, and about three hundred more in the North-West, the Punjab, Oudh, and the Central Provinces, which train pupils for the different University Examinations; and as it is simply impossible to expect that this large sum can be provided, the scheme must either be set aside, or a great number of the private schools must be kept out of the influence of the University. It might be said that, instead of giving complete sets, a few models may be supplied to begin with, and others may be secured according to circumstances. But that will convert the proposed thorough practical teaching to a mere sham, and book knowledge will take its place.

<i>* Colleges.</i>			
Government ...	11		
Private ...	6		
	—	17	
<i>Government Schools.</i>			
Higher Class...	53		
Middle „ ...	8		
	—	61	
<i>Private Schools.</i>			
Higher Class...	82		
Middle „ ...	526		
	—	608	
		—	669
<i>Normal Schools for Masters.</i>			
Government ...	27		
Private ...	6		
	—	33	
		—	719
	Total ...	719	

10. Supposing that the apparatus could be provided, the question would arise as to who are to use them? It is admitted that the present Head and Second Masters of Mofussil schools are quite incapable of handling them to advantage, and the plan proposed to bring them for a month to Calcutta during the cold weather, to secure a few lessons in manipulation from Mr. Woodrow, is simply impracticable. The heads of the Government zillah schools may be brought together: but they represent but a fraction of the total number who have to be taught.

11. The Committee desires that the replies of the Entrance candidates to questions on Physical Science should be accompanied with "good figures."

But no provision has been made for the supply of Drawing Masters for the preparatory schools, and none can be made for several years to come. From the statistics of the Government School of Arts, published in Mr. Atkinson's reports, it would appear that a dozen teachers a year are all that can be expected for the supply of the thousand schools which have to be provided. I am informed that the number of pupils in the Art School has greatly increased of late, but not at all to the extent that would be necessary to meet our wants.

12. Taking these circumstances into consideration, I am of opinion that a simpler and more practicable plan should be adopted to start with, and improvements may be thought of when we are able to command the necessary means and apparatus. Accordingly, I would suggest that, for the present, the subjects noted in the Appendix, and taken from the matriculation standard of the London University, which is simpler and much more consistent, be adopted; that the subjects be taught in schools through class books like Chambers's Course, and that the Government may be requested to provide zillah schools with sets of apparatus as far as practicable, and to appoint qualified teachers, who may travel from school to school and deliver courses of lectures with practical illustrations, so that the boys, having first learnt the rudiments in class books, may have opportunities of seeing their practical illustrations with the aid of models. The taste and necessity which will thus be created for practical knowledge, will gradually lead to every school being supplied with the necessary apparatus.

13. With regard to the F. A. Course, I regret I have to object to Drawing as a compulsory subject carrying marks, a want of qualification in which will lead to students being plucked even if they pass most successfully in other branches of their study. The London University does not include it in its curriculum, and, however valuable it may be as a part of liberal education, it does not in Europe form a compulsory branch of the F. A. Course. To be unable to appreciate the laws of perspective implies a kind of ignorance similar to that of not being able to distinguish between a basso and a tenor voice, or the soprano from the mezzo soprano, but few would be disposed to say that it would be a disqualification for an F. A. or a B. A. pass. The proper place for elementary lessons on Drawing are training schools, and the Director of Public Instruction can take the necessary steps to secure it there. The University, legislating for the Arts Course, can have nothing to do with it. This is a subject, however, which will be taken up in connection with Surveying and Civil Engineering, which have been lately recommended by Government to be introduced into our colleges, and need not, therefore, be further noticed.

14. The recommendation of Physical Geography for the F. A. Examination has very much the appearance of placing the cart before the horse. That subject is not a distinct science by itself, but the application of various sciences to the elucidation of the physical peculiarities of the earth and its surroundings. To be able to appreciate it implies a knowledge of Astronomy, Geology, Zoology, Botany, Hydrostatics, Optics, Pneumatics, and a variety of other sciences; and as these are made optional for the B. A. Course, I cannot perceive how it can be taught without them in an F. A. class. I have no doubt that a treatise on the subject by so able a physicist as Mr. Blanford will be as simple and easily intelligible as possible, but it is difficult to conceive how students will be able to understand it who have not some training in the sciences which lie at the base of it. It may be taught to some extent in an unintelligent categorical way, but the Committee has very properly begun its report by entering a solemn protest against it, and few will, I imagine, attach any value to such parrot-like teaching. The subject belongs to the B. A. Course, to which it should be relegated.

15. As a text book for Botany has been named, it is not necessary to notice the schedule of questions on that subject suggested by the Committee. I cannot, however, help taking exception to some of the natural orders which have been recommended for especial study. The Capparideæ, for instance, which, however important to Europeans as including a favorite condiment of theirs (capers), are quite unimportant, comprising only 64 Indian families, none

of which is of value in an economic, medical, or ornamental point of view. The greater part of the Gintianaceæ, according to Voight, "inhabit the Himalayas, Khastri mountain, Nilgris, and other mountains of both Peninsulas of India and Ceylon, but few are found in the plains," and those that are found on the plains are mostly insignificant. The Polygonaceæ are equally unimportant in every respect. The Legperaceæ are a widely distributed order rivalling the Gramiæ in the northern latitudes; but, according to Royle, "they differ from the Panicaceæ much in utility, inasmuch as the order contains but few plants which are of any importance, and of these the value depends upon the presence of mucilage and fecula in the roots of a few species, accompanied in others with a little bitterness and some aromatic principle." The most useful species of the family in Bengal is the reed which yields our house mats. I think it would be much better to replace these by orders which are economically of high importance, such as the Teliaceæ, one of which yields the jute or *pat* of commerce, of which Bengal enjoys a trade worth a million sterling; the Urticaceæ, yielding the mulberry, the source of our silk trade; the widely distributed Anacardaceæ, and the like.

16. The importance attached to the sixth question, which is "to carry half the marks of the whole paper," appears to me to be quite disproportionate to its value. To students who are expected to know every thing about phyllotaxis, metamorphosis, vernalion, ærtivation, stepulation, placentation (Question 3rd), and the distinctive characters of nineteen of the most comprehensive natural orders (Question 5), the mere counting of the calyx, corolla stamens and pistels of "the conspicuous flowers" of three or four different species, and recording their adhesion and cohesion, cannot by any means be a difficult task. The merest tyro can do it. It can imply no depth of knowledge in Botany, bearing in mind that the examiners can insist on only one-fourth marks for pass, as in most other sciences, and two papers can at least be set on the subject. I can only take it as equivalent to sanctioning the pass of every boy who can enumerate the number of stamens and pistels in a conspicuous flower.

17. The work on Zoology recommended by the Committee (Milne and Edwards) appears to be judicious, and should be adopted.

MANIKTOLLAH ;
The 1st September 1871. }

RAJENDRALALA MITRA.

APPENDIX.

NATURAL PHILOSOPHY.

MECHANICS.

Composition and resolution of statical forces.

Simple machines (mechanical powers.)

Ratio of the power to the weight in each.

Centre of gravity.

General laws of motion, with the chief experiments by which they may be illustrated.

Law of the motion of falling bodies.

Hydrostatics, Hydraulics, and Pneumatics.

Pressure of liquids and gases, its equal diffusion, and variation with the depth.

Specific gravity, and modes of determining it.

The barometer, the siphon, the common pump, Forcing-pump, and the air-Pump.

OPTICS.

Laws of reflexion and refraction.

Formation of images by simple lenses.

RAJENDRALALA MITRA.

MEMORANDUM.

I AM of opinion that the introduction of the study of Natural and Physical Science into schools and colleges in India is extremely desirable. I think, however, that the question, as affecting schools and colleges, should not be considered as one scheme. The scheme for schools should be entirely distinct from the scheme for colleges, although one should lead naturally up to the other.

The Committee have wisely considered that the teaching should be of a *practical* character. This cannot, I think, be too carefully borne in mind. With regard to schools, this is especially necessary. Young students are apt even in England to look on their studies as requiring only memory and sharpness, whilst they do not consider that reflection ought to be employed to teach them the *reality* of what they are learning. The case of the head boy of a Geography class is to the point. He answered every question with the utmost readiness according to the letter of the book. When asked what idea the term "Africa" conveyed to his mind, he hesitated, and, when pressed for his real opinion, replied that he thought it might be *a star*. This kind of knowledge is far too common even in England. In the Indian schools it is probably the rule rather than the exception. Practical knowledge certainly requires to be taught, and Natural and Physical Science is obviously the most practical medium for such instruction; but I think the scheme laid down by the Committee for the Matriculation Examination is too ambitious. It is without doubt sufficiently practical and possibly practicable, but I do not consider it desirable.

The opinion of the Committee "that *some additions* may be made to the present course with advantage, since it is stated, by those well qualified to speak to the facts, that the present course is insufficient to occupy many of the candidates up to the age of admission to the examination" is, doubtless, correct. But such a comprehensive scheme as that laid down by the Committee for the Entrance Examination seems to me to be far too much of an addition. I fear it would swamp all the other subjects, and, although very attractive to the students, yet its very attractions might be an evil in drawing away their attention and study from other important subjects. Properly to get up such a course as the schedule proposed in Appendix A., would be in itself a labour entitling a student to matriculation in a Science University without studying any other subject whatever. This result can hardly, I think, be intended by the Syndicate.

I would, therefore, suggest that the scheme should be very much modified and simplified, to make it a desirable course of study for matriculation candidates.

I quite agree with all that the Committee say regarding Geometrical Drawing, with the projection of simple objects, and free hand-drawing in outline. I would add thereto instruction in mapping, especially directed to Physical Geography, a subject in which Indian students are usually grossly ignorant. The elements of surveying might also be advantageously taught, with the use of the Plane Table and Theodolite, both in theory and in practice. This might readily be done, and would be a fair addition to, rather than a supplanting of, the present curriculum. I think that a study of the definitions and easy propositions of the XIth Book of Euclid would be very useful for the understanding of the possibility of considering lines to lie in more than one plane, an idea not usually grasped by beginners. This would be easier and more useful than the VIth Book. Such propositions of the Vth and VIth Books as are essentially required might be taken as proved without much detriment to the even course of Geometrical study.

Elementary Astronomy, consisting of facts and statements without calculation or theories, would be an easy, interesting, and useful addition. Finally, with regard to Appendix A., I cannot but consider it far too comprehensive and engrossing to be a desirable addition to the Entrance Course. Considered as a schedule of study, it is, in my opinion, admirable; but yet it is not suited to an Entrance class.

I would then propose that, instead thereof, an easier scheme be tried, which would answer every purpose. One of the many courses published in England for the use of schools, or the edification of the family circle, might be advantageously introduced, containing the *mere elements* of Natural and Physical Science, with easy and familiar examples; or a book might be expressly compiled applying peculiarly to India. This book should not be considered as a cram-book, and the examiners should be careful to make it the basis for the development of thought and observation, rather than to treat it as a course from which little or no deviation may be allowed. The evils of cram-books are too well exemplified already in the Entrance Examination of the Calcutta University, the many so-called keys to the English Course nullifying or stultifying the main objects of an Entrance Examination.

Leaving now the Entrance Examination, I will speak briefly of the F. A. and B. A. Examinations. The study of Natural and Physical Sciences could hardly be properly introduced without a radical change in the Examinations themselves. This radical change I would not hesitate to make. These Examinations have been hitherto conducted on the plan pursued by the University of London. This system is to teach the student a smattering of many subjects, and to encourage *cram*, that mushroom of London growth. Even as it is, the number of subjects required to be got up for the F. A. and B. A. is so great, that no student ever properly masters any one of them. He attains a little knowledge in each, and this, eked out by such hints as are to be found in the Indian Student and similar sources, enables him to prepare himself to pass the ordeal of cram. He is quite bewildered and confused amidst the variety of subjects, he makes most ludicrous and childish mistakes, and he can never be so prepared as to feel confident of success. A few marks lost in some partially neglected subject, or a few mistaken answers sent up in his confusion, will upset the hopes of the most promising pupil. To add one more compulsory subject to such an examination is clearly out of the question. The gap between the Entrance and F. A. is even now too great. Of the multitudes that annually pass the Entrance Examination, how few get through the F. A. This is not as it ought to be, this is not as it is in the Universities of Oxford and Cambridge. It is true that in India there are other distractions at work that do not have so much effect in England. Yet, making every allowance for all this, the falling off in numbers between the Entrance and the F. A. of the Calcutta University is far too great. I attribute this to the radical defect of the Examination itself. The Committee, in speaking of "optional subjects," have struck upon the right word, and it only requires a proper development of this to effect the change required. Let the Cambridge, Oxford, and German system be tried, which consists of a test examination in a certain number of compulsory subjects, and then an optional course of a few subjects for the Arts Degrees. The success of this system is proved by results in England, the failure of the London system in Calcutta is allowed. Let then the optional system be tried, whereby a student, after passing the necessary test, is enabled to devote his time to mastering his favorite subject. He enters *con amore* into his work, and thinks no more of cram and its repulsive horrors. I would then propose that, instead of the present F. A. course, the following be substituted :—

(1.)—English, compulsory.

One only of the following optional subjects :—

(2.)—Mathematics.

(3.)— { Languages.
 { Mental and Moral Sciences.

(4.)— { History.
 { Mental and Moral Sciences.

(5.)—Natural and Physical Sciences.

The B. A. degree to be taken upon any *one* of the above subjects, Nos. 1 to 5. Thus a more thorough study of the above subjects would be enforced, and a more searching examination instituted. The results would be more trustworthy,

and scholarship would be assured and ascertained. Appendices A., B., C., if combined, might form a suitable scheme for the F. A. Examination in Natural and Physical Sciences; and the scheme laid down by the University of Cambridge for the ordinary B. A. in Natural Science might, with some slight modifications, suit the Calcutta B. A. Examination.

In conclusion, I may say that I feel confident such a scheme would be very popular among Indian students. The candidates for the F. A. and B. A. would increase prodigiously in number, and the percentage of successful candidates would rapidly approximate the desired standard.

BENARES;
The 2nd September 1871. }

W. H. WRIGHT, B. A.,
Officiating Principal, Benares College.

No. 49, dated Gowhatty, the 4th September 1871.

From Baboo LAKHMI NARAYAN DAS, Head Master, Gowhatty High School, to the Registrar of the Calcutta University.

WITH reference to the report on the subject of Physical Science, and your endorsement thereon, I have the honor to state that I am fully alive to the importance of the study of Physical Science as a means of education. Its influence on the habits of the students is what is highly desirable. A spirit of inquiry and observation is engendered and fostered, and this is what is greatly needed by the generality of the students.

But although it is desirable that Natural Science should form a part of the courses fixed for the University Examinations, I cannot concur with the Committee appointed to report on the subject in proposing that it should be introduced into the Entrance classes of the schools. The subjects taught for that examination are already too extensive and complicated to admit of addition. Except a few favored boys, all the Entrance candidates find it beyond their power to digest and assimilate the vast knowledge required for the examination, and the consequence is that they generally forget what they learn for the examination.

In my opinion the study of Natural Science should be introduced into the College classes only; and that making it a compulsory part of the courses, the study of Mathematics and Moral Science may be left optional.

A similar substitution of subjects in the Entrance Examination will, I presume, not prove beneficial,—*firstly*, because the mathematical course for the Entrance Examination has a great practical importance, and therefore should not be left optional; *secondly*, because with the limited knowledge of the Entrance candidates the subject will not be intelligible and interesting to them, and the object of its study, the beneficial influence on the habits, will not be attained.

There is another reason which also dissuades me from proposing such substitution in the Entrance Examination. In my humble opinion the aim in this examination should be to test how far the candidates have a fair knowledge of the idioms and construction of the English language, in which only they can receive higher education, and this knowledge they shall find a great obstacle to acquire if they be hampered with a multiplicity of subjects.

Memorandum on the scheme of the Natural and Physical Science Committee appointed by the Senate of the Calcutta University.

OUR present course, even in the classes conferring University distinctions, is so completely circumscribed within book-learning, so little develops independent thought, and is so confessedly open to cramming, that there can hardly be two opinions as to the expediency of any change which may tend to obviate

these weighty objections and to give a more practical and generally useful direction to the education we impart. I pass at once, therefore, to consider the scheme put forth by the Committee, which though only provisional, yet being based mainly, as it is, on that already developed, and successfully worked, in the University of London, may be settled so as to require but slight alteration in subsequent years, and preserve intact its main features and outline.

I remark, *first*, that the only subjects new to the scheme, *i. e.*, the Physical Geography of India and Drawing, are eminently requisite in this country, and that the latter, if limited, as is proposed, to giving conception of figure and teaching outline perspective, apart from the more strictly professional aids of colour and shading, is quite practicable.

But I notice, *secondly*, a material difference in the list of subjects selected for experimental illustration from that laid down by the University of London, in that Optics and Acoustics are altogether omitted here, though they appear in every list of the London University, from the most elementary for women up to the most advanced for doctors in science.

I am willing to allow that the latter of the two (*viz.*, Acoustics) is somewhat removed from the actual needs of every-day life, yet the former (Optics) is most obvious, interesting, and easy of illustration. Moreover, whilst this is omitted, the more recondite group of Heat, Magnetism and Electro-magnetism, which the Senate in London have (wisely I think) relegated to the later examination for certificates of higher proficiency for women, are here inserted and required from our candidates for matriculation. This, in my judgment, is a grave mistake.

I notice also in passing that in the schedule of magnetism a candidate is to give a general explanation *why* "the compass points in a northward and southward direction." I presume this is a clerical error; for, in the little understood state of the phenomena of terrestrial magnetism, few would have the hardihood to pronounce dogmatically *why* the needle so points. Even Brooke's Natural Philosophy (Churchill's Manuals), Brandis' Dictionary of Science and Art, and the English Cyclopædia,—much higher works than masters of zillah schools could be expected to get up,—do not venture on the theory; and it would be absurd to require an explanation from mere boys. The facts of science are as much as we can demand from them. Indeed, the schedules generally appear to be only a rough draft, and their enunciation might be much amended on revision.

The most open field for discussion lies in how much, and at what stage of our course, shall the new subjects be brought in. It is not very clearly stated what are the Committee's views here; nor do I understand from the scheme how far they wish them to be additional to the present course or substituted for a portion of it.

I gladly accede to the proposed additions to the Entrance Examination, because I think the distinction gained by passing, and it is no mean one, has hitherto been awarded to very inferior attainments, and the standard may be, and has easily been, reached by lads of immature age, as is proved by the recent petition to reduce the age qualification. Only I consider the subjects of Heat, Magnetism and Electro-magnetism too advanced and far less useful than Optics, which I would substitute.

The present course for the First Arts Examination, even when the VI. Book of Euclid shall have been transferred to the Matriculation Examination, as it most assuredly ought to be, is, in my opinion, by far the hardest in a student's career. Every branch of it is heavy,—(1) the Literature by its bulk, higher standard and the higher requirements of the examiners; (2) the Metaphysics as being the introduction to an entirely new field of enquiry, and a subject confessedly difficult to a beginner, however far advanced otherwise; and (3) the Mathematics, because the learner now first encounters the difficult conceptions of general formulæ, infinite series, the Arithmetic of Trigonometry, and its application, &c., &c. Lengthened experience convinces me that the mathematical portion requires much more labor than the comparatively meagre one subsequently demanded of candidates for the B. A. Degree without honors.

Herein is the germ of two evils. Many are deterred from proceeding to a degree under the idea that the mathematical course will necessarily be proportionately longer and more difficult than that of the First Arts Examination, which, though a natural inference, is altogether wrong; and again a large number of those who do go on fail in these easier subjects from their inability to apply their Algebra and Trigonometry to Physical subjects from want of practical familiarity with them.

I put forth these remarks simply to show the grounds of my belief that it will be injudicious to superadd anything to the First Arts Course, and therefore Physical Science if introduced—and I concur in thinking it should be—must displace some one of the present subjects, now as one object in education chiefly at the expense of the State must be the production of men fitted to fill usefully the subordinate public offices as far as this object is regarded. Metaphysics undoubtedly may best be spared. Even looking at the matter generally, and without special reference to the wants of the State, I doubt whether the modicum of Metaphysics, which can possibly be acquired by those, and they are the greater number, who only reach the First Art Examination, is of any use whatever, either in actual life or as an incentive and introduction to future private study.

Lastly, I do not hold that Natural History lies in the same category of necessity or utility to a good ordinary education as Mechanical and Natural Philosophy in the common acceptation of these terms. Therefore I could the more readily omit as superfluous, unless as alternative subjects, Zoology, Botany, and even Inorganic Chemistry, from the B. A. Course, certainly at least the first of these three.

To sum up briefly, the course I would advocate is as in the schedule below :

Proposed Schedule of alterations in the present course to admit Physical Science.

Additions to the Entrance Examination.	Substitutions in the F. A. Examination.	For the B. A. Examination.
The VI. Book of Euclid. Elementary and experimental at least as far as in Gleig's series. Mechanics. Pneumatics. Hydrostatics. Optics (omitting Dynamics and Hydrodynamics).	Physical Geography of India. Heat— Electricity. (?) Magnetism. Electro-magnetism, as in Gleig's Series, or similar standard. Drawing. Geometrical Outline. Freehand ditto and Drawing to scale plane figures, only as in place of Reid and Abercrombie.	Inorganic Chemistry. Botany. Zoology (? ?) Drawing. Isometric Projection as substituted for, or alternative to, Metaphysics.

BAREILLY;
The 4th September 1871.

}

A. S. HARRISON,
Professor of Mathematics, Bareilly College.

No. 1418, dated Nynce Tal, the 11th September 1871.

From R. GRIFFITH, ESQ., M. A., Officiating Director of Public Instruction, North-Western Provinces, to J. SUTCLIFFE, ESQ., M. A., Registrar, Calcutta University.

I HAVE read with great interest, and very carefully considered, the report of the Committee appointed by the Syndicate on the best mode of introducing the study of Natural and Physical Science into schools and colleges in India.

2. I fully recognize the very great importance of the proposed measure, and the remarkable ability that has been displayed in the preparation of the scheme; but I have no hesitation in saying that the plan cannot be carried out in these Provinces for several years to come. In the three Government colleges there would, perhaps, be no insuperable difficulty as far as teachers are

concerned ; but the candidates for the Entrance Examination would be very few, and I doubt whether more than two or three in each college would succeed in the yearly examination. The students of our first school class are far inferior in their knowledge of English to students in the corresponding class in the schools of Bengal. The present studies occupy the whole time of the teacher and the pupil, and the majority of our boys have the greatest difficulty in passing the existing tests in English and Mathematics. The addition of an extra book of Euclid will break the backs of many : nearly all will sink under the weight of experimental Statics, Hydrostatics, Pneumatics, Heat, Magnetism, and Electro-magnetism. It should be borne in mind that our boys will not only have to attempt to get up these subjects, but they will have to learn the language in which the new science is conveyed. Almost every word (and the words are not very easy) will have to be explained. It will be utterly impossible at present to introduce the proposed system into our zillah schools, or missionary schools of similar status. There are no teachers who can give instruction in the new subjects ; there are no funds to provide additional masters ; and it is impossible to send the present masters for a month to Calcutta or even to Benares.

3. The scheme in its present shape is, in my opinion, utterly impracticable in these Provinces. It cannot, I think, be introduced until the general knowledge of English has greatly increased, and until the Government is willing to increase, at a considerable expense, the instructive staff of the zillah schools and the grants-in-aid to missionary institutions.

4. I enclose remarks on the subject by Mr. Constable, Inspector of the 1st Circle, Department Public Instruction, and Mr. Rogers, Officiating Inspector of the 2nd Circle.

No. 138, dated Meerut, the 22nd August 1871.

From E. J. CONSTABLE, Esq., Inspector, 1st Circle, Department Public Instruction, North-Western Provinces, to the Director of Public Instruction, North-Western Provinces.

WITH reference to your docket No. 1173 of the 15th instant, and its enclosure, I have the honor to make the following remarks and suggestions.

1. I agree with the Committee in thinking the engagement of trained teachers most necessary for the practicability of the scheme. Masters proceeding to Calcutta for a month or so would probably return indifferent manipulators, in which case the practical instruction they could impart to their subordinates and their pupils would be limited and poor of its kind.

2. To insure the *practical* character of the teaching, I would suggest the non-publication of "an elementary text-book for use in the schools," containing popular explanations of the experiments, as I think such a publication would lead to that very "mere book knowledge" it is so desirable to avoid. The pupils should acquire their "knowledge of things" from the oral instruction of the lecturer, by watching attentively his manipulations, and by manipulating the apparatus themselves. Finally, I consider this portion of the Entrance Examination should be *vivâ voce*, and that it should involve at least the manipulation of some half a dozen instruments. As the Entrance candidates examined at one place are not very numerous, I think the above plan would be practicable. A pamphlet of directions for the use of the apparatus would be very useful.

3. Dynamical experiments should be included in the scheme. Medical men can often say with truth that nature requires rest : with equal truth, perhaps, the mathematician can say that nature abhors rest as much as it does a vacuum. Everything is in motion, and the laws of motion therefore should, if possible, be experimentally illustrated.

4. The Committee's remarks on Drawing are, in my opinion, very valuable, and I think the study of the art should be introduced earlier. It might be added to the course laid down for the higher classes in zillah schools. Ability to draw in perspective would be very advantageous even in a mathematical point of view.

5. I concur in the opinion that some editions might be made to the Entrance Course.

6. In conclusion, I think Physical Geography and Elementary Chemistry might be introduced into the First Arts Course if Psychology and Logic were excluded. Similarly Chemistry and Physics might be added to that for the B. A. if Mental and Moral Philosophy were expunged. Whether or no benefit would thus accrue may possibly be deemed an open question. I am inclined to think myself that the establishment of a Natural Sciences Tripos, subject to regulations similar to those in vogue at Cambridge, is the only way of avoiding a fragmentary course of scientific instruction.

No. 128, dated Agra, the 4th September 1871.

From E. E. ROGERS, Esq., M. A., Offg. Inspector, 2nd Circle, Department Public Instruction, North-Western Provinces, to the Officiating Director of Public Instruction, North-Western Provinces.

I HAVE read with much interest the proposed scheme for the introduction of Physical and Natural Science in schools and colleges.

I fully agree with the Committee that in our colleges the introduction of a more systematic illustration of physical principles by means of experiments is highly desirable. I have had considerable experience as a mathematical lecturer, and have from time to time illustrated the practical bearing of certain physical principles; but I have never made use of this method until my pupils have been tolerably familiar with the principles I have desired to illustrate; and for this reason experiments are liable to complete failure, or the actual results are so far from the premised results that, unless a lecturer is so intimately acquainted with his subject as to be able to explain why these results differ from the computed ones, the effect is to shake the belief a student has in the truth of the principles under discussion, and raise doubts in his mind of the exact utility of a science which fails to make practice agree with theory. I think that the Professors are properly qualified as far as theoretical knowledge is concerned, and a very little practice would give them the requisite manual skill: a fixed system of experiments to illustrate their physical lectures might, therefore, be adopted in our colleges without delay.

With regard to the zillah schools in this circle, I think that the scheme is premature; the fact is we have no zillah teachers capable of becoming physical lecturers with any probability of imparting any clear knowledge of physical principles, even assuming that the teachers could grasp the principles themselves.

The result of introducing the proposed scheme would be a number of partially educated men trying to explain to a class that which they do not properly understand themselves, and illustrating it by experiments which, from want of manual skill on their part and the unavoidable imperfections of the machinery, would too often fail.

This is no fancy picture. Taking into consideration the large number of able men in England with all the resources at their command to ensure the success of their experiments, how few we find who in a popular course of lectures succeed in successfully bringing home the truths of Physical Science to their hearers, and how many of the experiments are forced to succeed by little arrangements unknown to the audience and unsuspected by them.

I remember the late Professor Couper, of King's College, relating on one occasion he wished to illustrate the principles of vertical velocities in a manner suggested by Poinot, and in which a small weight attached to a string which ought to have remained stationary positively refused to do so, thus utterly destroying the use of the experiment, except to those of their audience who, for other and independent reasons, knew beforehand the truth of the principle enunciated. Again and again did the experiment fail, until a clever assistant ingeniously passed a pin through the string which effectually prevented the weight from descending, and the experiment was apparently successful, and the lecturer loudly applauded.

The deduction from such a mishap in the case of a zillah school-master, who had but a slight knowledge of the subject, would be that the theory was wrong, and not the machinery in fault; he would be expecting invariable success in his experiments, and be utterly helpless when they failed. Moreover, in the zillah schools of this circle the pupils are still struggling with the English language, and, until simple and accurate books in Hindee are obtainable, little can be done to give a fair idea of even the simplest theory, and of the select few who grasp their favourite subject enough to make a wrong deduction few will have the opportunity or inclination to pursue it after leaving school.

I have no doubt that itinerant lecturers in zillah schools would draw large houses as long as there was no charge for entrance, but that the good done by them in the diffusion of Western science would be infinitesimal.

To conclude, my opinion is that a system of experiments to illustrate lectures in Physical Science is highly desirable in our colleges, but at present of no possible use in our zillah schools for want of both qualified teachers and suitable pupils.

No. 69, dated Ajmere, the 11th September 1871.

From C. H. DEMELLO, Esq., M. A., Officiating Principal, Ajmere College, to J. SUTCLIFFE, Esq., M. A., Registrar, Calcutta University.

IN compliance with the wishes of the Syndicate, I have the honor to submit my remarks on the report of a Committee appointed by the Syndicate to report on the best mode of introducing the study of Natural and Physical Sciences into schools and colleges in India.

The Committee open their report with the following remarks :

“ The Committee have endeavoured to fulfil two fundamental conditions :
The first and most essential is, that the execution of the scheme shall be practicable ; the second, which is only second in importance, is that it shall inculcate teaching of a practical character.”

From this I infer that a question of a prior and primary importance had not been submitted for their consideration, but had been previously decided by the Syndicate. It is evident that the Entrance Course has, after years of experience, been found defective, and that the introduction of the Natural and Physical Science will give it a completeness and perfection so absolutely necessary.

I differ from the Syndicate in this question. The standard prescribed for admission into the Calcutta University cannot be considered low, as a comparison with those adopted by other Universities convincingly proves. Dr. Husband, of the Scotch United Presbyterian Mission, who has just come out, writes that the Matriculation Examinations of the colleges in Scotland are—

- | | | |
|----------------------|--|---------------------------|
| 1. Elementary Latin. | \| | 3. Elementary Arithmetic. |
| 2. Elementary Greek. | \| | 4. Elementary English. |

Natural and Physical Sciences are entirely excluded ; and in Mathematics, Arithmetic appears only to be included, though Mr. Smith, the Mathematical Teacher of our college, who is from the Aberdeen University, says that a knowledge of the Ist Book of Euclid is expected. This Entrance Course falls short of the prescribed one of the Calcutta University.

The test for admission into the Lahore University is similar, as far as practicable, to the tests observed in the Continental colleges. Every candidate is required to take up at least one classical language and one branch of general knowledge ; and the minimum qualifying marks 125 from full marks aggregating to 200.

The Calcutta University has its Entrance Course modelled after that which is adopted by the London University, and, as may be expected, it is more comprehensive and much higher in standard than either of the Scotch or Continental Courses. There are no less than four different subjects embraced, in which two classical languages are included (for English cannot be considered a vernacular with the Natives of India), and in all of which the candidate must

pass, gaining a minimum of marks certainly not lower than that fixed in Universities where the Course is more limited and the standard lower. The subjects are—

1. English.
2. Arabic or Sanskrit.
3. Mathematics—
 - (a.)—Arithmetic, the whole.
 - (b.)—Euclid, I—IV Books.
 - (c.)—Algebra to Simple Equation.
4. History—
 - (a.)—History of England.
 - (b.)—Ditto of India.

Surely the above Course is amply sufficient; and, since it so immeasurably surpasses the Courses of other Universities, any suggestions to increase its range appear quite unnecessary. It may, however, be argued that advanced as the Course is for Indian lads, or at least for Bengali lads, who are extremely precocious, it is not sufficient; and under this conviction it has been determined to enlarge very considerably the Entrance Course by the introduction of the Natural and Physical Sciences.

It may seem presumptuous on the part of all whose knowledge of Bengal must be very limited and unreliable to differ from the Syndicate in a matter of such paramount importance, more especially when the Committee, whose report is under review, state—“With regard to the Entrance Examination, indeed, it appears, from facts recently laid before the Senate, that some additions may be made to the present Course with advantage, since it is stated by those well qualified to speak to the facts that the present course is insufficient to occupy many of the candidates up to the age of admission to the Examination.”

What these facts are, we in the North-West have not the means of ascertaining; but, referring to the University Minutes and Calendars, we find no corroboration of these facts. The following extracts from a Note, drawn up at my request by Mr. Harris, B. A., Head Master of the Ajmere College, are deserving of every attention, coming from an officer who has for years been preparing, and preparing very successfully too, candidates for the Entrance and the First Arts Examinations.

“I.—I would solicit attention to the following statement, based upon statistics published in the Minutes of the Calcutta University for 1870-71, with reference to the Entrance Examination for December 1870:—

	Passed, 1st Division.		Passed, 2nd Division.		Passed, 3rd Division.		Total Passed.		Failed.		Number of candidates.
	No.	P. C.	No.	P. C.	No.	P. C.	No.	P. C.	No.	P. C.	
All the provinces represented ...	202	10·9	587	31·5	315	16·6	1,099	59·	765	41·	1,864*
Bengal alone ...	157	10	...	...	...	...	866	55·3	700	44·7	1,566
N. W. Provs. alone ...	26	14·8	...	...	...	...	114	66·1	61	34·9	175

* Excluding absentees.

“It is hard to reconcile the above results with the Committee’s statement, that the present test is insufficient, and consequently the introduction of fresh subjects practicable. Did the yearly statistics show a fairer proportion of candidates who had obtained a first class

certificate, did it even show that the *bulk* of the examinees had passed in the 1st and 2nd Divisions, we might have been justified in accepting their assertion. But with the glaring fact before us, that out of the 1,864 *select* candidates who represented the various provinces at the last Entrance Examination, the larger half, by 98, failed totally or partially (*i. e.*, passed in the 3rd Division) we cannot but come to the conclusion that, whatever the defects of the Entrance test, insufficiency is not one of them. The other general results brought out by the tabular statement may be thus stated roughly :

“1.—Only 11 in a hundred of the candidates took a first class.

“2.—The number of failures equals the number passed in the 1st and 2nd Divisions.

“The figures for *Bengal alone* are still more unfavorable, and lend no countenance to the supposition implied by the Committee, that the prescribed Course, though possibly hard enough for the North-Western Provinces, is too easy for Bengal. A glance at the two last lines of figures will satisfy us on this point. The comparison there drawn shows that while Bengal completely distances the Upper Provinces so far as the total number of passed candidates is concerned (the relative proportion being 8·9:1), in all other points it contrasts unfavorably with them. I do not mean to insist upon all the inferences which might be drawn from the comparison ; but making every allowance for insufficient data, and for contingencies inseparable from large classes, it must, I think, be admitted that, although education is more widely spread in Bengal, the matriculation candidates there are, at any rate, not of a *superior* stamp to those sent up from the North-Western Provinces.

“II.—In the next place, how many instances have we of boys coming up to the Entrance class before completing their 16 years ?

“I can speak with confidence with reference to the Agra and Ajmere Colleges, and I believe that the records of these institutions will show that not a single candidate, either Hindu or Mahomedan, has as yet been kept back from considerations of age. It will not answer to say that this is due to Native boys entering school at an advanced age. An intelligent boy, commencing English at eight years of age, would require fully eight years' study at a well-organized and well-conducted institution before he could be fit to compete at the Entrance Examination. This is not a mere vague surmise, but is, if anything, too *low* an estimate.

“The Ajmere College receives into its primary class as young children as any institution I know of, and yet the average age of its Entrance candidates, calculated for the last two years, is 18·9, and the average period of study 8·6, thus giving 10·3 as the average age at which they entered school. These averages are, I believe, as near as possible, true generally for the North-Western Provinces.

“How far these remarks will apply to Bengal, my experience of that Province is too limited to determine. But judging from the large number of candidates who failed last year, and the small proportion of those who took a first class, it seems probable that the North-Western Provinces, in this respect too, keep pace with Bengal within an inappreciable degree of difference. I, however, lay no stress upon this presumption ; for, even assuming the very reverse to be the case, my argument remains substantially the same, at least it leads to the same conclusion—Can the Entrance test be *too easy* for Bengal when, notwithstanding the fact that a goodly proportion of the candidates had had an extra twelvemonth given them for training, 44·7 in a hundred failed, and only 10 per cent. passed in the 1st Division ?

“III.—In point of fact, I would appeal to every teacher, who has had the bringing up of an Entrance Class, if the task did not in

every instance demand his best exertions before it could be satisfactorily performed. I do not mean to doubt the judgment of Inspectors, but I would respectfully urge that these officers, who visit a school on the one day it is best prepared to receive them, who see but the result and not the process by which it has been arrived at, are scarcely in a position to form an adequate idea of the labour it has cost the workman."

Having endeavoured to show that the Entrance Course of the Calcutta University is as comprehensive as any adopted by older Universities, and that though there might be occasionally a few lads who have mastered the Course before the prescribed age, yet, as a rule, the bulk of the candidates can only find themselves prepared for such a test after an instruction of 8 to 9 years, and after they have completed their 18th year, I will now draw attention to the report of the Committee. I feel convinced that a radical error has been committed. The question submitted for their consideration was the best mode of introducing Natural and Physical Sciences into our schools and colleges in India. As the University has been established for the better encouragement of Her Majesty's subjects of all classes and denominations in the pursuit of a regular and liberal course of education (Act of Corporation), the Syndicate, doubtless, contemplated the introduction of the Natural and Physical Sciences in a mode fully consistent with the principles which have hitherto guided the University in regulating a course of studies for the different branches of Literature, Science, and Art. Solidity, accuracy, and completeness must be the characteristics of every scheme which can hope to recommend itself to its favorable consideration. The scheme suggested by the Committee has one of the two fundamental conditions kept in view by them, that is, it shall involve teaching of a practical nature. Had such a scheme been drawn up for a Mechanics' Institute, or for national schools, such as are under the control of the London School Board, it would be unexceptionable; but for the University it has not a single recommendation. The Committee characterize their own scheme fragmentary and unsymmetrical, and hence it cannot be incorporated in a course for the promotion of a regular and liberal education. The introduction of the VIth Book of Geometry will, I think, be admitted to be hardly necessary for the object the Committee have in view when it is stated that the Survey Departments, Trigonometrical, Topographical, and Revenue, are content to admit candidates who have mastered the four books of Geometry. I condemn the entire scheme for the Entrance proposed by the Committee in unqualified terms, as one which should be rejected, even if it were found necessary to introduce the Natural and Physical Sciences into the Entrance Course. I am not singular in my opinion in condemning the scheme as quite unsuited, from its fragmentary and purely practical nature, for students in the pursuit of a regular and liberal course of education. The Head Master writes—"Not only must the mind be made familiar with the phenomena presented by natural objects, or illustrated by philosophical instruments, but the *principles* involved in them must be carefully analyzed and intelligently understood. This in the present instance will be found impossible. All the teaching that will be practicable, will result at best in an empirical handling of *philosophical toys*. A pupil trained under this system may work a model telegraph, exhaust the receiver of an air-pump, or exhibit the Magdeburgh experiment, but he cannot be expected to have acquired the power of applying the principles he is continually employing to the explanation of natural phenomena. Mere book knowledge and the art of reproducing words are certainly worthless, but the knowledge of *things alone*, and the art of repeating descriptions of them by rote will prove not a whit more profitable.

"Indeed they are likely to do positive harm. Happily-devised experiments are the allurements which entice the student to the study of sciences, and encourage him in overcoming details which require severe application. By familiarizing the mind with these experiments at a stage at which they cannot be combined with the corresponding theoretical instruction, we shall deprive the more serious study of the Natural Sciences of its proper reward, and thus render it in a measure repulsive to the advanced students."

Defective, fragmentary, and impracticable as the proposed Course for the Entrance Class is, the suggestion of preparing Head Masters of zillah schools, by

summoning them to Calcutta to receive instruction in their new duties in contemplation for them, appears to be still more condemnatory. Schools, as a rule, whether in the North-West, Punjab, or Bengal, have a weak, or at most a barely adequate staff, and besides the general control and supervision of the schools, the immediate instruction of the two upper classes devolves entirely on the head masters. To remove these men for three or four months from their posts of trust would be to disorganize the schools, lower their standard of instruction, and so materially affect their moral tone as to render all progress for a time nearly impossible. Head Masters themselves, apart from the hardships and humiliation they must experience, will certainly not, as a body, benefit from their visit to Calcutta. Many of them, doubtless, are fairly advanced in years, and past instruction; others have no taste for the Natural and Physical Sciences, and will make no progress; others, again, from natural timidity and awkwardness, will find manipulation an invincible barrier, which all their personal exertions and the superior instruction on the part of the lecturer will never remove, while the fair number of young intelligent Head Masters, with a special aptitude for these sciences, will, from the short period of their stay, be effectually prevented from reaping any substantial benefits. Thus one and all, or at least nine out of ten, will return from Calcutta to find their schools in a lamentable state of disorder and backwardness, and the work of years completely destroyed, or; at least, very materially injured. The sufficiency of the Course for Arts has never been questioned, and if doubts did exist, a reference to the University Calendar would dispel them. From the large number that pass the Entrance Examination, few remain to prosecute their studies to First Arts tests.

The report of the Syndicate on the business of the year 1870-71 shews that, for the First Examination in Arts, 540 candidates were registered, of which 233 passed, 255 plucked, and 12 were absent. Of the successful 28 were placed in the 1st Division, 97 in the 2nd Division, and 97 in the 3rd Division. As it is well known that those who pass in the 3rd Division seldom continue to prosecute their studies for the B. A. degree, the number of successful candidates will be correctly represented by those who pass in the First and Second Divisions, that is, of the 540 candidates registered, 136 only passed. Had Indian lads to pay for their University education anything approximate to what is paid for a University education in Europe, failures, such as mentioned above, would seriously affect the growth and progress of our Indian colleges.

As matters stand at present, I believe every student, whether in Bengal or the North-Western Provinces, who passes in either First or Second Division at the Entrance Examination, receives a scholarship sufficient to maintain him in college. But to prepare for the First Arts many find themselves unequal; and some idea may be formed of these withdrawals by a glance at the statement below:

Candidates who passed the Entrance Examination in 1868	...	...	892
Candidates who presented themselves at the First Arts Examination	...	...	...
in 1870	...	...	233

Of course this is only an approximate ratio; but making a fair allowance for withdrawals from other causes, the bulk must be correctly attributed to the trying test of the First Arts Examination. I do not advocate the lowering of the standard, but I do protest against trifling and experimenting with it. The steady advance made year after year by the colleges of Bengal and the North-Western Provinces to the standard fixed by the University is deserving of every encouragement; and the introduction of any measure or change, before the prescribed standard has been fully attained, must be condemned as premature and injudicious.

Whatever advantage the course of instruction in Natural and Physical Sciences as proposed by the Committee may possess, inasmuch as it involves teaching of a practical character, it cannot be recommended to supersede studies which are the essentials of a liberal education, and which develop and train the powers of observation and reflection most effectually and thoroughly. I would let the present course of the First Arts Examination remain unchanged, not that it is the best but because

it is best suited to the present state of education in India. All who have any experience in the work of Indian education will bear testimony to the perseverance, diligence, and earnestness of the undergraduates of an Indian University. Their period of stay in college is one unbroken period of study. Neither cricket nor boating, neither hunting nor racing, neither social parties nor mental recreations break into the monotony of study, and yet the Indian students have no time for general reading. They are so uninterruptedly and wholly engaged with the University Course, that the full amount of their knowledge is in their text-books. Captain Richardson, for years the Principal of the Hindu College, remarked that the Hindu was unequalled as a student, that for natural intelligence and indomitable perseverance he stood second to none; and yet as a man he failed completely to realize the promises he had given as a student. The fact is evident, that for years the standard of education was higher than it ought to have been; but, with the advancement of education, our Indian students will find that the College Course will not engage their time to the entire exclusion of all general and necessary information. Let the present First Arts Course be completely attained, let the bulk of candidates pass in the 1st and 2nd Division, and then we may safely consider whether an improvement may not be effected by the addition of a few studies.

My remarks on the First Arts Course may be applied to the suggestion of the Committee for change in the B. A. Course. What is absolutely necessary for a B. A. is accuracy, depth, solidity, not a comprehensiveness which makes superficiality unavoidable, in fact essential. It may be inferred, from the remarks made, that the Physical and Natural Sciences should not be introduced into our University Course, and to some extent this inference is correct. I am of opinion that it is premature and injudicious to introduce them at so early a stage as proposed by the Committee, but where the student has passed the two great ordeals—the Entrance and the First Arts test—he may be invited to attend a course of lectures in Natural and Physical Science extending over a period of two years.

A comprehensive and well-matured syllabus may be drawn up and lectures delivered illustrated by experiments such as the resources and means of a college alone can command. Attendance to these lectures to be optional, excepting for those who intend to enter the Educational Department. Graduates who can produce certificates of having attended the entire course of lectures in Natural and Physical Science to have a preferential claim to appointments in the Department. We may in time, if this proposal be adopted, have the truths of Natural and Physical Science disseminated, not by crammed Head Masters of zillah schools, but by scholars thoroughly qualified for the great work entrusted to them.

No. 94, dated Patna, the 11th September 1871.

From J. K. ROGERS, Esq., Officiating Principal of the Patna College, to J. SUTCLIFFE, Esq., M. A., Registrar, Calcutta University.

WITH reference to the report of the Committee appointed for framing a scheme for the introduction of Natural and Physical Science into schools and colleges in India, and in accordance with the request contained in your endorsement dated 9th August 1871, I have the honor to state that the scheme prepared by the Committee supplies what has long been felt as a want in the course of instruction pursued in Government schools and colleges in this country, *viz.*, Natural and Physical Science in a simple and popular form. I concur generally with the Committee, both as regards the subjects to be introduced and the mode of teaching them differing from them only as respects the distribution of the subjects. I fear that the course laid down for the Entrance Examination is too extensive, and would be found impracticable to be carried out, especially in zillah schools, with such agency as they can command. I would, therefore, suggest that the portion relating to Heat, Magnetism, and Electromagnetism be transferred from the Entrance Examination to the optional list of subjects in the First Arts Examination, and that Chemistry be excluded from the First Arts Examination, as it forms one of the subjects of the B. A. standard.

I fully agree with the Committee as to the necessity of modifying the standard of the First Arts Examination. Some of the subjects now compulsory must be made optional, otherwise it will not be possible to introduce the scheme of Natural and Physical Science proposed by the Committee. The examination which the First Arts candidates have even at present to undergo is wide in its range of subjects, and comparatively more difficult than the Matriculation and the Degree Examinations; it will not consequently be judicious to add to the burden of those candidates. But while I would be glad to see them relieved of some of the existing subjects, I would, with reference to Metaphysics, not make the whole of it optional, for that would virtually lead to its entire abandonment. I would retain Logic among the obligatory subjects, but would let the rest be optional.

Relief for the First Arts candidates may be obtained, not only by making some of the compulsory subjects optional, but by lessening the quantity set in English Prose and Poetry. The English First Arts Course in literature for this year (1871) is a bulky volume, and so is that fixed for the B. A. for 1872. A smaller quantity would be more thoroughly got up, and would leave spare time for other subjects. Drawing, both free-hand and instrumental, appears to be very desirable. I therefore readily endorse the opinions expressed on the subject by the Committee, and think the introduction of Drawing will be attended with very beneficial results.

In conclusion, I beg to say that I see no reason to doubt the practicability of the scheme proposed by the Committee, if their suggestions are carefully and intelligently followed.

Dated Lucknow, the 25th September 1871.

From M. J. WHITE, Esq., M. A., Officiating Principal, Canning College, Lucknow, to J. SUTCLIFFE, Esq., M. A., Registrar, Calcutta University.

IN reply to your circular of the 9th August, I beg to offer a few observations on the report of the Science Committee.

I am certain that the proposed scheme for introducing Physical Science as a part of the regular curriculum in schools and colleges will be welcomed both by teachers and students. By the former it has always been considered a defect in our present educational system that a thorough ground work in the elementary principles of Science has formed no part of it. It is obviously inconsistent that we should be sending forth every year hundreds of students from our colleges who can criticise Milton and Shakespeare, and discuss the comparative merits of Mill and Hamilton, and who, at the same time, are almost as wholly ignorant of the most ordinary phenomena around them as the humblest coolie in the bazaar.

I know from experience that the students would like the change; for I have observed that any little casual explanations on scientific subjects which I have given them have been listened to with eager interest, and looked upon as a special treat and a relaxation from the more serious work of preparing for examinations.

Every argument in favor of the teaching of Science applies with increased force to the students under our charge. The strongest of these arguments is, that it cultivates habits of observation. No habit would be more valuable to an Indian student than this. His imagination and his love for dreamy speculation require to be checked rather than stimulated, but his powers of observation appear to be completely dormant.

Many of the students, when they leave us to engage in the business of life, have no opportunities of continuing their course of reading in the subjects which they have been taught, and they have a great tendency to relapse into a state of mental torpidity. But it would not be so as regards their knowledge of Science. Opportunities for increasing that knowledge would always be near them, wherever they might be situated, and I feel sure that a taste once acquired for scientific truth is that one above all others which is least likely to be lost.

Moreover, it has been our professed aim that the knowledge imparted by us should not remain confined to the student himself, but that it should spread outwards from him as a centre to those around him. Correct notions on science may thus spread; but I question much whether all that the majority learn of Sanskrit, Arabic, and English Literature will ever go much further than the student himself, even if he retain what he has acquired.

It is likely to be an objection to the course proposed, that it will give a mere smattering of Science. But it will depend entirely on the state of teaching, whether this be the case or not. If it be of the practical nature suggested by the Committee, the objection cannot possibly hold good. The often-repeated maxim "drink deep, or taste not," does not apply here. The little that is given, if properly given, will whet the appetite and create a desire for more, and it will go hard if, in such a variety as is presented by the scheme, each student does not find some branch of science specially attractive and suited to his peculiar tastes.

I do not anticipate much difficulty in having the subjects properly taught. The demand will speedily create a supply of efficient teaching power. Neither do I think that any part of the present course need be superseded to make way for Science. Even though the learning of Science were the veriest drudgery, it seems to me that the Native memory has so marvellous a receptive capacity that it would be fully equal to the task. But the subject is most attractive, and the lectures upon it would lighten other labours instead of increasing them. The course might, however, be modified. If, for example, all the time spent in hunting up references in the English Course, and in committing to memory unteachable text-books on history were saved, there would be more than ample time for carrying the classes through the course of study proposed by the Committee. Besides, the task of teaching the higher classes will, year after year, become less laborious; for one great difficulty in such work has been that the teaching in the lower classes has been imperfectly performed; but this difficulty will gradually disappear, as junior masters, well educated and trained to their work, take the place of the half-educated and inexperienced teachers whom we have had hitherto.

I do not think that Drawing should be made *compulsory*. The power of producing a good drawing, even after any amount of instruction, is the gift of a happy few; and, therefore, the examiner in this subject must either be extremely lenient with the majority, and thus make his examination of no use, or he must demand from them what Nature herself has refused. I can understand that those who are skilled in the use of the pencil will probably take a different view of the matter; it is natural that they should see no difficulty where they themselves find none.

I would also omit Zoology. The study of this subject will probably, in most cases, consist merely of cramming the dry details of a text-book.

If the scheme proposed be adopted, the results will depend primarily upon the examiner, and not upon the teacher. The latter works with the former in view; and, if each examiner gives *invariably* that practical nature to his questions which is insisted upon by the Committee, there will be no doubt of success.

MEMORANDUM.

I REGRET having delayed so long in responding to the compliment paid me by the Syndicate of the Calcutta University in having been requested to express my opinion on the proposed scheme for the introduction of Science into the schools and colleges.

It seems to me that the difficulties that arise will not be found to depend so much on the ultimate development of a practical system of teaching in the schools, as in carrying out a scheme which will be thoroughly feasible in their present circumstances, of means in the sense of securing a thoroughly practical system of teaching, for where are we to find Native teachers possessing a thorough knowledge of the facts of Natural Science?

So far as the schools are now concerned, it appears to me that the practical and practicable are merged in one common dilemma. Since the existence of a staff of thoroughly qualified teachers, or the materials from whence they could be drawn, this would not be much difficult in developing a system of instruction, such as that proposed by the Committee, that would be suited to the schools; but so long as such a class of instructors does not exist, I am disposed to believe that all efforts should for the present be concentrated on the colleges.

The only class of men that might be available, as at all qualified to teach Science in the schools, are a few graduates in medicine who, however, would find much more congenial and lucrative employment in the prosecution of their own profession than they probably would do were they to become instructors in subordinate educational establishments. But how very few even of these have ever manifested a thorough and practical acquaintance with Science. I am not aware of any Calcutta student of Botany who has ever formed an herbarium for himself, nor of any student in Zoology who has ever anatomised animals from a simple desire to become familiar with the structure of plants and animals, and I much doubt whether the majority of these students have more than a book-knowledge to guide them.

It is proposed by the Committee to bring the Head or Second Master of a zillah school to Calcutta for a month, or possibly more, to instruct him to manipulate the apparatus for teaching Experimental Physics; but, unless he has had a previous training in the principles of that most extensive domain of science, I much doubt, however skilful he may become as a manipulator, that he would be a lucid teacher, or sufficiently intelligible to his pupils. His experiments might divert the youthful students without taking hold of his mind. It seems to me that too much importance should not be attached to experiment if it is unaccompanied by clear explanatory teaching, and unless it is made subservient to the communication of knowledge; for, as a rule, ignorant people are attracted to any experimental display of natural phenomena without caring to enquire into its causation.

From what has been stated, it will be apparent that I am inclined to regard the introduction of Natural Science into the schools at present as premature. First of all, should not the teaching of Science in the colleges be made more effective, by having a higher place assigned to it in the curriculum and taught in a thoroughly practical manner, and should not the examinations of the students be conducted, as far as possible, by a direct appeal to natural objects? Were the students taught and examined in this way, may we not rest assured that they would make a point of having a practical acquaintance with the subjects of their study? As in Europe, should not the knowledge be tested more effectually by oral examination and by the familiarity which the student exhibits with the objects that might be placed before him? As also in Europe, should not encouragement be held out by awards being offered to those who distinguish themselves in forming good herbaria of districts, in executing chemical experiments, and in bringing together collections of zoological objects in the shape of dried specimens and skeletons? Were Science duly recognized in the colleges, and a more persistent practical character given to its teaching, as a sequence we would obtain a class of men capable of imparting a satisfactory elementary knowledge of it in the schools.

There is no reason why the introduction of Natural Science into the schools should not be kept steadily in view; and this intention being generally understood, college students would qualify themselves accordingly, especially if, by so doing, they established a prior claim for appointments to masterships. Teachers thus efficiently trained would have resources in themselves which would suggest materials for the right illustration of the facts of Science which it might be their object to explain and exemplify, *e. g.*, selecting the common animals and plants of their districts and demonstrating the structure and functions of their parts, while, in Physical Science, they would make an intelligent use of the apparatus recommended by the Committee.

With reference to the University Entrance Examination, the only point in which I do not concur with the Committee is in the introduction of the VIth

Book of Euclid, which might be reserved as a subject for the First Arts Examination.

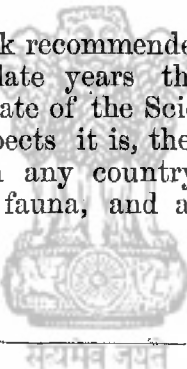
Again, as to the latter examination, it appears to me that too high a position is assigned to Drawing as a means of cultivating the observing faculty. In the practice of Geometrical Drawing by the aid of instruments, the mind is dependent on something outside itself for its accuracy, and in the case of free hand-drawing in outline some students will in a very short time acquire proficiency, whilst others will never attain to it, indicating that it is very much a natural gift.

In regard to my own special department, I observe with satisfaction that the Committee recommend Zoology as a subject of study and examination in the course for the Degree. There is no subject better adapted to "develop and train the powers of observation rather than those of mere memory," and no subject that has illustrations more readily at hand, and the teaching of which can also be explained by models of animals which cannot be easily preserved by dissected models and by enlarged representations of microscopic forms. With such materials, there is no department of science that can be more thoroughly taught and illustrated; and as living things have a much greater attraction with the majority of minds than inanimate objects, there can be little doubt that Zoological instruction would be generally appreciated. Such being the qualities for teaching Zoology in the colleges, its elements could be most readily introduced into the schools, illustrated, as I have indicated before, by common forms of animal life, and their skeletons, which are overtly prepared and preserved.

With regard to the text book recommended by the Committee, Zoological Science has so advanced of late years that to adopt Milne Edwards's Book would be to revert to the state of the Science as it existed some 15 years ago, and, good as in other respects it is, the foregoing is a serious objection. Besides, in teaching Zoology in any country, the illustrations, if possible, should be drawn from its own fauna, and a text book should accord with the teaching.

The 26th September 1871.

JOHN ANDERSON.



MEMORANDUM.

THE introduction of the Natural and Physical Sciences into the schools and colleges of India, will doubtless mark the dawn of a new era in the history of education in the country. While it is universally admitted that much has been done within the last half century to familiarize the Natives with the literature and history, the mathematics and philosophy of the West, scarcely anything has been attempted to make them acquainted with the riches and wonders revealed by those sciences, which constitute the chief glory and distinguishing feature of our age. The Hindus, indeed, have had a rich literature of their own from the remotest antiquity, while the keenness of the Hindu intellect in grappling with the subtleties of Metaphysics is universally acknowledged. But not a single Hindu has yet appeared, who may be styled an observer of nature in the proper acceptation of the phrase. The Hindu has been too much accustomed to look within, but has never yet been taught to look out of, himself. To bring his mind, therefore (as the Committee's scheme proposes to do) into direct and living contact with the works of nature, which his own land presents in such rich and varied aspects, and thereby to educe its powers of observation and comparison, would, indeed, form an entirely new phase in its development.

It appears to me that the practical study of the Natural Sciences, especially Zoology and Botany, will when fairly presented, commend itself to many in the upper classes of Native society. They can command the means and the leisure necessary to their successful cultivation, while the study is admirably calculated to foster and gratify that passion for the perpetuation of names so characteristic of them by opening out the path of discovery. While much

has been done to extend our knowledge of Indian Zoology by the labors of such men as Hodgson, Blyth, Jordon, Cantor, Sykes, and Walter Elliot, and of Indian Botany by those of Wallich, Griffith, Royle, and Wight, a great deal yet remains to be accomplished. And in the course of another decade or quarter of a century, when those sciences shall have become thoroughly incorporated into the curriculum of our Indian colleges and schools, it may not be unreasonable to expect that Natives, imbued with scientific knowledge, will follow in the wake of those eminent men, and leave their names indelibly inscribed on the rolls of science.

While the cultivation of the Natural Sciences is thus calculated to gratify an honorable ambition, that of the Physical Sciences will be attended with vast practical utility to the country. Their important bearings on the manufactures, agriculture, and the arts generally are too well known to need any comment. It will be a happy day for India when a practical knowledge of these sciences shall be widely diffused among her sons. All true friends of Native progress and enlightenment will, therefore, hail with delight the determination of the Syndicate to make them a regular part of the University curriculum, as well as the valuable suggestions of the Committee to give it practical effect.

With reference to the several details of the Committee's scheme, I beg heartily to endorse their recommendation to insist upon some knowledge of drawing as a necessary part of education. To say nothing of many other reasons that might be adduced in its favor, a knowledge of it is essential to the successful cultivation of the natural sciences; for, unless the hand can correctly delineate what the eye observes, it will always be felt to be a great drawback. Next to a specimen, a drawing will convey a better idea of an object than any description, however graphic. I would here beg leave to suggest that a knowledge of drawing might be advantageously introduced into the Entrance curriculum in connection with the study of geography. This has been done to some extent in the Doveton, and with excellent results. Those boys who excel in map drawing find no difficulty in obtaining employment in the Government Survey.

In respect of the Science Course recommended in the scheme, I beg to observe that, admirable as it is in many respects, it is nevertheless fragmentary, as the Committee candidly admit. Entrance candidates, for instance, are limited to some branches of experimental science,—those for the First Arts, to Elementary Chemistry and Botany, while those for the Degree have the option of electing either Chemistry, Physics, or Zoology. There is thus very little scope afforded here for the study of Zoology and Botany. I am aware of the reasons which must have weighed with the Committee in confining those branches respectively to one examination, but am of opinion that the objections to their more extensive introduction are not insuperable. There are, doubtless, some among the educational body in the country who are already qualified to teach those two branches of Natural Science, with special reference to the Fauna and Flora of India. And a class of lecturers in Zoology and Botany, as well as Chemistry and Physics, might be easily trained, say at the Medical College, in the course of a year or two, to supply the schools and colleges. I have no doubt that Botany will soon become a favourite branch of study, especially in the mofussil, from the facility of procuring specimens, as well as from its inherent attractiveness. Nor ought there to be any difficulty in imparting a practical knowledge of Zoology in a Presidency city like Calcutta, possessing a museum like the Indian, one of the richest in the world in respect of indigenous specimens. I beg to suggest, therefore, as a slight modification of the Committee's scheme, that a graduated course of Zoology, Botany, and Physics be drawn up, suited to the several examinations from the Entrance upwards, making it optional with colleges to elect one or two subjects, for it will be beyond the power of most non-Government colleges to provide more than one Professor, unless the Government furnish the means. There will thus be a greater probability of turning out men sufficiently imbued with scientific knowledge, instead of mere smatterers in science. Moreover, it will afford an opportunity to any college of becoming in time a distinguished school of some particular department of science.

If the object of the Committee is, as they insist, to diffuse a practical knowledge of the subjects they recommend, and prevent cramming, Milne

Edward's work on Zoology will hardly answer their purpose; for there is but little in it directly bearing on the Fauna of India. The subject might be taught by lectures, or if a text-book is considered indispensable, one might be compiled, suited to the wants of Indian students. And if some knowledge of Physiology, along with Zoology, is regarded as essential, Professor Huxley's elementary work on the subject, or even the one in Chambers' Educational Course might be advantageously substituted for the syllabus contained in Milne Edwards. The work in Chambers' Course has the advantage of containing directions for practical illustrations.

In conclusion, I beg to express my conviction that, if the subjects recommended for the Entrance Examination be *added* to the present course, it will entail considerable hardship on future candidates. The Committee are under the impression that the present course is insufficient to occupy many of the candidates up to the age of admission to the examination. Had they substituted the word *some* for *many*, the statement would have been nearer the mark. If the opinions of those who train such candidates, that is, the head masters of Government and other schools, were taken on the subject, I hardly think that they would be found to corroborate the Committee's statement. At all events, the results of the Entrance Examinations seem to point in an opposite direction. Of the large numbers who annually present themselves, about one-half are regularly "plucked," and of those who pass, a comparatively small number only are placed in the first grade. The subject in which the most considerable number of failures takes place is Mathematics, and to this the Committee propose to make a formidable addition in the VI. Book of Euclid. It is, therefore, to be hoped that the Syndicate will see the propriety of making additions to the Entrance Course as gradually and insensibly as possible. For the present, Drawing might be confined to Map Drawing and the Books of Euclid already in use, while to make room for any branch of Natural or Physical Science, a portion of History and Geography might very well be excluded. This, however, is thrown out merely by way of suggestion.

The 9th October 1871.

H. ROBERTS,
Offg. Principal, Doveton College.

No. 98, dated the 10th October 1871.

From BABU SHIVA PRASAD, Inspector, 3rd Circle, Department Public Instruction, North-Western Provinces, to the Director of Public Instruction, North-Western Provinces.

IN answer to your docket No. 1175, dated 15th August last, I have the honor to inform you that the Committee make "two fundamental conditions,"—the first "that the execution of the scheme shall be practicable," and the second, that it shall involve teaching of a practical character." Presuming that the conditions are the same on which education is carried on in England which we must take as a model for us, I fully agree with the Committee. When we place English B. As., or M. As., in juxtaposition with our Indian B. As., or M. As., respectively, we find a great difference; whilst the former knows more or less everything which is useful, and derives great pleasure from his power of observation, the latter is, comparatively speaking, of very little use to himself or to society in large, and with no power or even taste for observation. The object is, or it ought to be, to remove this difference. But the Committee have selected for our First Arts Examination an elementary Chemistry extracted from the "London University Examination for women in 1869," omitting the section on Heat! Cannot we learn even as much as the women of England learn? And why has it not been extracted from the examination for men? The aptitude of Indians to learn anything which Europeans can learn is universally acknowledged, and the Government will not stoop so low as to confess their inability to give us the same kind of education as is given to the sons of Great Britain. However, the Committee say that they provide only a "scheme for introducing science," and look forward "to the possibility of enlarging and systematising it as the not distant result." I am confident this possibility will very soon turn into a felt necessity.

2. I do not agree with the Committee when they say "several subjects that would find their place in such a course have been altogether omitted

from the Committee's scheme, since their teaching is not compatible with one or other of the two fundamental conditions already specified." To deprive India of the knowledge of frictional electricity for the dampness of the climate of Bengal seems utterly inexplicable. In my opinion Geology, Mineralogy, and Human Physiology are as important as anything can be, and are, I think, urgently required.

3. I approve of drawing, but am much opposed to requiring a knowledge of the VI. Book of Euclid in the Entrance Examination.

4. I fully agree with Mr. Woodrow and Mr. Clarke in the practicability of the scheme, and have no hesitation to say that "what is proposed by the Committee can at once be carried out in the schools." I can send with your permission all the head masters of my zillah schools and some other teachers to Calcutta as soon as I know the time fixed by Mr. Woodrow for teaching them "to manipulate the apparatus."

5. I am strongly in favour of making "these sciences compulsory, and to remove one or more of the present obligatory subjects" "to the optional test" only to "admit," but not to "compel," the introduction of Physical Science, will be equivalent to no introduction at all.

6. Much will depend on the "little book of directions for the use of the apparatus." We cannot do without books. It will be a great mistake if too much reliance is placed solely on the explanation of the teachers. The London School Board are wiser in putting out "a sketch of lectures (or rather an elementary text book) for use in the schools which explains popularly the experiments in these lectures." Why do we not follow their example, or borrow from them, what they think necessary for the primary schools? Are we justified in supposing it to be too elaborate for our colleges?

Dated Agra, the 27th October 1871.

From the Principal of St. John's College, Agra, to the Registrar of the University at Calcutta.

I HAVE the honor to acknowledge the receipt of a copy of the "Report on the best mode of introducing the study of Natural and Physical Science into schools and colleges in India," and to forward you some remarks on the same.

2. I deprecate most strongly the increase of subjects of study for the Entrance Examination. My own experience leads me to expect that the object of the framers of the report is not likely to be realized in the way they propose. Sufficient subjects of study are now given to the students of the Entrance Class. The tendency to learn by rote instead of thoughtfully digesting the subjects studied is already too prevalent, and the introduction of new subjects of study will increase the evil. I feel certain that the students will resort to some descriptive manual of the proposed subjects of study, and the majority will content themselves with learning it off by heart. I therefore do not desire to see *any* of the additional subjects of study, including the VI. Book of Euclid, commenced before the passing of the Entrance Examination.

3. There seems to be a still greater strain upon those studying for the First Arts Examination, leading them to neglect, as far as possible, those portions of a subject which demand much exertion of the thinking powers. (Several of our students have broken down in health, and have given up study.) Under these circumstances I prefer, if new subjects are to be introduced at the higher examinations, that they should be introduced in the way suggested by the compilers of the report as optional subjects, and that all the subjects, except English, should be made "optional but not alternative subjects," &c.

4. On the proposed course of study, I remark that there would probably be more difficulty in teaching drawing in these Provinces than is anticipated in Lower Bengal; the botanical specimens proposed for description might not be procurable in the North-West; and, as a resident in a part of the country peculiarly favorable for carrying on experiments in "frictional electricity," I do not advocate its exclusion from the list of subjects. I do not, therefore, make

any further objection to the list of subjects, than to remark that the list, in what it includes and excludes, seems rather to consider the requirements of Bengal than the North-Western Provinces.

MEMORANDUM.

THE answers already given in on the question of extending the study of science in schools and colleges are so voluminous that I feel myself compelled to compass my suggestions into the smallest space that is consistent with perspicuity. This must serve as an excuse for any abruptness or boldness of style.

I think we can now safely assume that the number of those who are opposed to any and every extension of science in our educational system is exceedingly small. The overwhelming majority would say that the extension is desirable, if practicable. Some of these, who have vehemently contended against the particular plan proposed by the Committee, have at the same time expressly stated that they are "not adverse to an increased amount of scientific study in the colleges." We must, therefore, carefully distinguish between two things, *viz.*, 1st, the desirableness of more study of science, and 2ndly the mode of securing this which is proposed by the Committee.

I have come reluctantly but decidedly to the conclusion that the plan recommended by the Committee is open to very serious objections. It attempts too much. Our students cannot bear the additional burdens which the Committee wish to impose. Whatever may be the theoretical value of the scheme, it is for the present, and probably for years to come, unworkable. Even if I believed it the best mode, theoretically, of extending the study of science, I must oppose its acceptance for the present as involving a change in our educational system all too sweeping and too sudden.

I earnestly trust that the Committee and their supporters will not contend *à l'outrance* for one special scheme, for "the bill the whole bill, and nothing but the bill." If they do so, we have the prospect of strife in our University Councils for years to come. If, on the other hand, they consent to a change of their *plan*, it ought to be possible to prepare a measure and a method of the desired extension which would carry the suffrages of a large majority.

By far the easiest mode of extending the study of science in our colleges would be by carrying out a principle which is already recognized in our University system, that of optionality, or having alternative subjects.

Wholly apart from any question as to the study of science, many who take a deep interest in education are convinced that the time has come when the number of optional subjects in our curriculum must be increased. In this matter we have fallen behind the age; we are not only far behind Oxford and Cambridge, but considerably behind Bombay and Madras.

The Committee propose that an enlarged course of Natural and Physical Science be made *compulsory*, Mental and Moral Philosophy being henceforth relegated to the optional list. There are many of us who entirely fail to see either the expediency or the justice of making the distinction between Science and Philosophy, and of exalting the former at the expense of the latter. The quiet assumption by the Committee that this view will probably recommend itself to the Senate may well provoke a smile.

I propose that the enlarged study of science be optional, not compulsory.

The plan of the Committee affects our entire University curriculum from the Entrance Examination up to the Examination for Honors. As the whole scheme must at first be tentative, I think it would be much safer, as certainly it would be much easier, to alter our course, at present, only from the F. A. Examination onwards.

After the F. A. Examination, let the subjects of the students who take up science be as follows :

(1) English, (2) Mathematics as bearing on Physics, (3) Physics.

For those who take up the Natural History Sciences, perhaps Mathematics need not be compulsory, and in which case the course would be—

(1) English, (2) Natural Science (including Chemistry).

The student of Physics would thus be relieved of the second language of History, and of Metaphysics, and Moral Philosophy; and the student of Natural Science optionally relieved of Mathematics in addition.

There would be ample time, in the two years between the F. A. and B. A. Examination, for the acquisition of a large amount of scientific knowledge. But with many the course would extend over three years, as they would study on with a view to the Honor and M. A. Examination.

Perhaps a re-adjustment of the scholarship system might be advantageously made with the view of encouraging scientific studies. It would not be difficult to effect this.

So far I have spoken only of colleges. The Report of the Committee discusses likewise the best mode of introducing science into schools; and as it is for the University to decide the character of the Entrance Examination, the question of science in schools does fall to some extent within our jurisdiction.

One very serious difficulty in the way of such a measure is the want of qualified teachers. The University cannot desire to encourage cramming. It is, however, difficult to see how, for the present, the study of science in schools could be anything else than a mere exercise of memory instead of the powers of observation and intelligence. For educational purposes this would be of exceedingly little value. We shall do the work better by not doing it too hurriedly. If the scheme which has been briefly sketched in this paper be adopted, there will be in a very few years a body of Bachelors and Masters of Arts sufficiently qualified to teach science in schools. Moreover, the prospect of such qualified men finding speedy employment as teachers would be a powerful influence to attract students to the scientific classes in our colleges.

So much, then, strictly bearing on the interesting question of extending the study of science. But, as I have already said, we ought to carry out the principle of optionality with regard to other branches besides science. The easiest way of effecting this would be by increasing the number of optional subjects in connection with the B. A. Examination. At present, in addition to languages, History, Mathematics, and Philosophy, the student must select a fifth subject, which optionally is Mathematics, *plus* Physics, or Chemistry *plus* Electricity, or Zoology or Geology *plus* Physical Geography. He has then a choice, but it is Hobson's choice, and I believe that in all institutions, except the Government Presidency College, the student has no help but take up Mathematics although the subject may be utterly distasteful. Higher Mental and Moral Philosophy should certainly be added to the optional course, and probably, if a good many colleges desired it, History and Political Economy. In fact the list of optional subjects could be enlarged as experience might show to be desirable. All I now care to point out is that the addition of Mental and Moral Philosophy to the optional list of subjects for the B. A. Examination has already become an absolute necessity.

The measures that have now been proposed would not set aside existing arrangements. Students who preferred the course as it now stands could still take it up. But when, in addition to what is offered at present, there is the option of a course almost exclusively scientific or one mainly philosophical, it is certainly that one, or other of the two latter, will be preferred to the present course by the great body of the students.

CALCUTTA; }
The 3rd December 1871. }

J. M. MITCHELL.