THURSDAY, MARCH 3, 1870

NATURAL SCIENCE AT THE UNIVERSITY OF CAMBRIDGE

IN endeavouring to give a brief sketch of the aids and encouragements to the student of Natural Science in this University, it will simplify matters to arrange our materials under three heads: (1) Instruction, (2) Appliances, (3) Inducements.

(1) INSTRUCTION.—This may be subdivided into (*a*) University, (*b*) Collegiate. As the relation between the University and the Colleges is often not understood by outsiders, it may be well to preface this part of our subject by a word of explanation. As it would clearly be impossible in most branches of learning for one, or even several, professors to teach the large number of students now resident in the University, the greater part of the work has to be done by the staff of tutors and lecturers in the various Colleges. Hence, in practice, a system of division of labour has grown up. The Colleges look after the general education of their students, and do the heavy work, undertaking almost the whole instruction of the rank and file in the Arts and Sciences; while the professor is held to be the representative of his particular department, whose duty is to do his best to advance its study, and be the organ by which the latest advances in it are communicated to the University at large. His work, therefore, is to fine-polish the tools which the Colleges have prepared. Hence, in one of the more frequented branches of study,—say, for example, that of mathematics,—the great mass of students never attend a professor's lecture at all; for them the instruction provided by the Colleges amply suffices; his class therefore consists of only a few of the ablest students, and he confines his instructions to those very difficult branches of mathematics on which perhaps few men besides himself can speak with much authority. In the case, however, of a branch of study followed by only a small number—say Sanscrit—the care of all the students may fall on the professor; but then, as the class cannot be a large one, this is not too heavy a burden. When, therefore, the demand for instruction in any such branch increases, the Colleges, either singly in the larger or by combination in the smaller Colleges, appoint lecturers to relieve the professor by taking charge of the average students, and by preparing the more able to attend his classes. This last is exactly the position of the Natural Sciences at the present time.

(*a*) To return, then, after this digression to the University Instruction in the Natural Sciences. At the present time, without reckoning the two purely Medical Professors, there are six Professorships in the University: that of

	Founded in	At present held by
Anatomy*	1707	Dr. Humphry.
Botany	1724	Prof. C. C. Babington.
Chemistry	1702	Prof. Liveing.
Geology	1727	Prof. Sedgwick.
Mineralogy	1808	Prof. W. H. Miller.
Zoology	1866	Prof. A. Newton.

The number of lectures given varies considerably, depending mainly on the requirements of the students; the smallest being one course of four days a week in one term, while the largest is two courses each of three days a week in every term.

(*b*) Collegiate. Trinity College has one lecturer in the Natural Sciences; St. John's College has two; and the present lecturers have made arrangements by which the lectures are common to the two Colleges: the subjects thus covered being Physics, Chemistry, Geology, and Elementary Botany. Sidney Sussex College has one lecturer in the Natural Sciences, and Downing two "in Medicine and Natural Science." We believe that these lecturers also admit to their lectures students from the neighbouring Colleges.

(2) APPLIANCES.—The University possesses various collections, &c., accessible to students. These are: the Museum of Human Anatomy and Pathology, which is strong in the latter department, but not so well supplied in the former. The Botanical Museum, containing the collections formed by the late Professor Henslow with the herbaria of Drs. Lehmann and Lindley, and considerable additions that have been made from time to time. These for many years could not be properly exhibited owing to want of space, but they have been recently established in a suite of rooms in the New Museums and Lecture Rooms Buildings, and provided with convenient cases in which they are being rapidly arranged. There is also a large Botanic Garden, with hothouses, &c. The Professor of Chemistry has a small Museum of Chemical Preparations, with Laboratories that will accommodate about forty students at once. The Geological Museum, which occupies the ground-floor rooms under a part of the Public Library, had for its nucleus the collection of Dr. Woodward, the first professor. Since then it has been constantly augmented by many valuable gifts, and by the energy and liberality of the present occupant of the chair, the venerable Professor Sedgwick. It is peculiarly rich in Palæozoic, Cretaceous, and Eocene fossils; containing, among others, collections from the Cretaceous rocks by Mr. Image and by Dr. Forbes Young, of Saurians from the Lias by Mr. Hawkins, of Dudley fossils by Captain Fletcher. There is, we believe, no Museum where the palæontology of East England can be better studied. It also contains some good sets of Continental fossils, and a remarkably fine series of rock specimens collected by the present professor. On the whole it is a collection of which the University may justly be proud. The Mineralogical Museum now occupies a suite of rooms above that of Botany, and its arrangement is almost completed. It originated in the collection formed by Dr. E. D. Clarke; but has since been greatly augmented, having received the entire collections of Mr. H. Warburton, Dr. Forbes Young, Lord Lilford, Viscount Alford, and Mr. H. J. Brooke, besides large donations from Dr. Whewell and others. Rooms for purposes of study are attached to the Museum. The Museum of Comparative Anatomy contains the nucleus of a fine collection in Comparative Osteology, numbering more than 2,000 specimens, with a collection of Invertebrata and a Physiological series. It owes much to the energy and liberality of the late Professor of Anatomy, Dr. Clark, and of his son, Mr. J. W. Clark, the present superintendent of this and the Zoological Museum. The latter Museum, now in process of arrangement, contains some good collections of birds

* The University also provides a demonstrator in Anatomy to assist the professor.

and fishes. In the Colleges, there are laboratories at St. John's, Sidney Sussex, and Downing; and we believe that Trinity College contemplates establishing one.

(3) INDUCEMENTS.—The degree of B.A. may be obtained in Natural Sciences. An examination in Honours was instituted in 1851; in 1861 the regulations were revised, and the successful candidates were declared entitled to a degree. Ninety-five students have passed this examination in the nine years since the alteration. A candidate for an ordinary degree may also select for the subject of his third or final examination one of the following subjects: Chemistry, Physics, Geology, Botany, Zoology. In the Colleges: Clare gives annually a scholarship, value 50*l.*; Caius two, value not stated, one for Chemistry, the other for Anatomy; Christ's has lately offered scholarships, from one to four in number, and from 30*l.* to 70*l.* in value, according to the merit of the candidates; St. Peter's gives annually one of the value of 60*l.*; St. John's gives annually an exhibition of 50*l.* for three years to students commencing residence; this College has also just instituted an annual examination in the Natural Sciences for its resident students, for proficiency in which prizes in books and pecuniary rewards will be given, as in the other College examinations; Trinity gives annually one foundation scholarship, tenable till the holder is of M.A. standing; Sidney Sussex, two scholarships annually, value 40*l.*, with opportunity of promotion, for Mathematics or Natural Science; Downing gives annually at least one scholarship, value 40*l.* A fuller description of these will be found in No. 6 of this periodical, p. 169.

In looking through the lists of the Natural Sciences Tripos, fourteen persons will be found to have been elected fellows, but in most cases the candidate has been not without distinction in other branches of study. In several, however, proficiency in Natural Science was the declared cause of the election.

These statements are made upon the authority of the last volume of the Cambridge Calendar, supplemented in some instances by personal knowledge.

Thus much has been done: of what remains to do it is perhaps better that one, who is a resident and engaged to some extent in the work, should refrain from speaking. On this point only I may venture to express my conviction, that the coldness and even dislike with which the study of Natural Science was once regarded here is rapidly passing away, that the number of earnest students in the various branches is annually increasing, and that the University is fully alive to the wants of the age; so that, while she can never neglect or forget those old paths of Classics and Mathematics in which many of her sons have won an almost world-wide reputation, she will heartily welcome, and will regard with no less pride, all who are among the followers of sciences of a more recent date.

T. G. BONNEY

THE MEASUREMENT OF GEOLOGICAL TIME

II.

WE have now to consider an entirely distinct set of facts which have an important bearing on the probable time elapsed since the last glacial epoch. Messrs. A. Tylor, Croll, and Geikie have shown that the amount of denudation now taking place is much greater than has generally been supposed. The quantity of water discharged by several rivers and the quantity of sediment carried down by those rivers have been measured with tolerable accuracy, and allowing for the difference of specific gravity between sediment and rock, it can be easily calculated, from the known area of each river basin, what average thickness has been removed from its whole surface in a year, since all the matter brought down by the river must evidently have come from some part of its basin. In this way it is found that the Mississippi has its basin lowered $\frac{1}{6000}$ of a foot per annum; the Ganges, $\frac{1}{2358}$; the Rhone, $\frac{1}{1528}$; the Hoang-Ho, $\frac{1}{1464}$; the Po, $\frac{1}{760}$.

But it is evident that this amount will be distributed very unequally over different parts of the basin, according as the surface is flat or sloping, whether the slopes are of loose soil or of rock, whether the rock is solid or friable. The perfectly flat alluvial plains that form a considerable part of many river basins, will not only suffer no denudation, but will generally receive deposits of sediment during floods, and all such flat lands should therefore be deducted from the area of the river. Slightly undulating lands, especially if well covered with forest, will also suffer scarcely any denudation, as is well seen in the case of the Rio Negro branch of the Amazon and other black water rivers of South America, which hardly carry down any perceptible sediment even when in full flood. Again, wherever lakes occur, they receive all the sediment from the basin above them, which portion should therefore be treated by itself, since it contributes no sediment to the main river. If we look at a physical map of North America we see that a large extent of the Mississippi basin consists of alluvial flats and slightly undulating prairie, sufficiently explaining its small proportionate denudation. Even the Rhone, which has a high rate of denudation, flows through a great extent of low lands and perfectly flat meadows, while the upper portion of its valley which produces most sediment is cut off by the Lake of Geneva. In order, therefore, to arrive at any fair estimate of the amount of denudation in the upland and mountainous portions of the Rhone valley (which is what we require for our purpose) we have considerably to reduce the area of its basin by taking away the flat lands in all its valleys, and considerably to increase the amount of sediment by adding all that is now poured into the Lake of Geneva. We shall probably not be far wrong in adding one third to its denuding powers on these grounds, which will lead us to the startling fact that the Rhone basin is being lowered at the rate of a foot in a thousand years; but even this is considerably less than in the case of the Po. Mr. Croll takes the Mississippi denudation of a foot in six thousand years as a measure for that of Europe; but for reasons above stated I conceive this to be quite out of the question, and I maintain, that if we are to use his measure of denudation for any practical purpose, we must apply that of European rivers to European phenomena, that of Alpine rivers to Alpine phenomena, and must further make the necessary corrections for alluvial flats and intercepting lakes.

Mr. Croll and Sir Charles Lyell were at first both inclined to adopt the period of high excentricity which occurred from 750,000 to 950,000 years ago as that of the glacial epoch, but Mr. Croll, in consideration of the proofs of rapid denudation above given, now believes that the