NATURE of January 13, 1870, and the subsequent correspondence. The violet of the primary bow passed into red at its concave edge, and within this violet-red arc there was a faint appearance of prismatic colours, blue or green (and I think yellow), and then a distinct red arc, and within this again yet another very faint red arc. Between these last two the other colours of the spectrum, if they existed, were too faint to be seen; but the impression given by a *coup d'œil* was that of three complete series of colours. There was nothing beyond the red on the outside of the primary bow, except, of course, the secondary bow, at some distance.

This is the phenomenon alluded to by Mr. Justice Grove, in his letter to NATURE of January 20, 1870, in which he queries whether these colours are repetitions of the spectrum, such as are suggested by Sir John Herschel. Your correspondent, Mr. C. J. Munro (NATURE, February 3, 1870), appears to regard them as analogous to "Newton's Rings." I should much like to see the point more fully elucidated. Is it established that under no circumstances can the spectroscope show visible rays beyond the violet? GEORGE C. THOMPSON

Cardiff, Sept. 8

Cat's Teeth

I HAVE in my collection the skull of a cat, which has the peculiarity of possessing an extra molar tooth on the left maxilla; this tooth is tricuspid, and is situated between the last premolar and the carnassial tooth, on their interior side, so that it does not disturb their normal position. Will some of your readers inform me whether this is not very unusual? and whether from its position it does not overthrow Professor Owen's theory, that the two premolars are respectively third and fourth?

R. LYDEKKER

Harpenden, Sept. 2

DANISH EXPEDITION TO THE FAROES

THE United Steamers Company (*forenede Dampskibselskab*) in Copenhagen, having got a grant from the Government for the exploration of the Faroe coal-fields, is about to send an expedition to these islands, for the purpose of scientifically examining into the extent of the coal-fields in the north of Süderoe, and discovering in what manner coals may be best transported from that island to Copenhagen.

Besides having in view commercial purposes, the expedition will be accompanied by men of science, who will investigate the natural history of these little-known islands. The Government has asked Prof. Johnstrup to visit the different coal-fields on the southern island, and to investigate the geological features. The managers of the steam company, represented by Consul Koch, have also kindly allowed the writer of these lines to accompany the expedition for zoological purposes.

The geological features of the islands are best known from Forchhammer's researches, published in the "Transactions of the Danish Society of Sciences" (1828). The rocks of the Faroes are for the greatest part of volcanic origin, dolerite-porphyry being found in large masses in all the islands. Coal sediments are only to be seen in the south (Süderoe), and in the little islands of Myggenäs and Tindholm. To what formation these beds belong has not been cleared up, as fossils have hitherto not been discovered. But as the coal-fields of Iceland and Greenland, in which fossil plants have been found, belong to the miocene-tertiary period, it is very probable that those of the Faroes belong to the same formation. The researches which now are to be made by Prof. Johnstrup and his assistant, Cand. Geisler, will, we hope, throw further light upon the nature of these deposits.

The fauna of the islands, as far as the vertebrates are considered, was already tolerably well known at the beginning of this century, as may be seen from Landt's "Beskrivelse over Faeröerne," published in 1800. The only wild mammals inhabiting the interior of the islands are a few species of the genus *Mus*, which follow man's steps wherever he goes. But the shores of the Faroes are visited by a large number of *Pinnipedia* and *Cetacea*, from the capture of which the inhabitants have every year a good profit. The birds—those inhabiting the rocks of Store and Lille Dimon, as well as those of some of the other islands—have been made known by Graba, and, so far as they also occur in Iceland, by Faber. Later publications, especially by Swedish authors, are well known to have thrown much light on the natural history of these inhabitants of the north. Reptilia and Amphibia do not occur at all in the Faroes; but fishes of various species come to the shores and ascend the rivers in considerable numbers. They have been collected with great zeal by Sysselman Müller, of Torshavu, who has sent a list and specimens of all the species known to him to the zoological museums of Copenhagen. The lower animals are less known; we have lists of echinoderms and molluscs by Lütken and Mörch, and we know something about the worms from the investigations made there by Prof. Oscar Schmidt, who for a short time visited the Faroes. The writer of these lines hopes to gather further information about the lower animals by dredging on the shores of the islands; and, while collecting the fishes for the Munich Museum, he will continue his researches into the natural history of their parasites.

The expedition will leave Copenhagen early in September, and, when returning from the Faroes, may perhaps pay a visit to a Scottish port.

RUD. V. WILLEMOES-SUHM

Copenhagen, Sept. 4

NATURAL HISTORY EDUCATION AT HARVARD UNIVERSITY

WE reprint the following interesting article on the scientific instruction given in Harvard University from the pages of the *American Naturalist*:—

The changes which have been made in the departments of Natural History at Cambridge within the last two years have been very great, greater perhaps than in any other school within the same time. As there are many persons of both sexes who are seeking opportunities for study such as the University now offers, we give a sketch of the plans of education in the different schools as far as they concern the student of natural history. There are five schools in the University where natural history is taught: the College, the Museum of Comparative Zoology, the Botanic Garden, the Scientific School, and the Bussey Institution. Let us trace in a general way the course of a student in these departments.

The student who enters the college to-day is no longer compelled to follow the one uniform road over which the boy of twenty years past had to go; after his first or freshman year, he may begin to turn himself into the paths of natural science. At the commencement of his second year he may begin his studies by courses which lay the foundations of a knowledge of chemistry, taught in the laboratory; of physical geography, geology, and meteorology, taught by text-books, lectures, and excursions in the field. The time allowed for these studies during the year is estimated at twelve hours per week. It is expected that the student will in this year lay the foundations for the work he may wish to do during the following years, by getting that general idea of the physics of the globe which forms the necessary basis for the work of the naturalist in any department of labour.

With the junior year the studies of a strictly biological character begin. One course includes the elements of comparative zoology, with elementary teaching in

microscopy, another the elements of botany, a third the elements of comparative anatomy. The principle on which the teaching of zoology is based is that the student should at the very beginning be put into the position of an investigator. With this object in view the student is at first required to do all his work upon natural objects. Beginning with the solid part of a Fungia, or some other object of equal simplicity, the student is then required to draw and describe the specimen, aided only by such questions and suggestions as may be necessary to get him over the worst obstacles. As soon as he has done the little he can do in the way of close observation, he is given a Manacena or Agaricea, which he proceeds to compare with the Fungia, and so making at least diagrammatic drawings with a dozen other specimens of Polyps, Halcynoid and Actinoid. Thus the student gets some idea of the general relations which exist among the members of that group. When, say, in thirty hours of labour he has got through this work, a few lectures serve to supplement and connect the knowledge he has obtained from the personal study of the dry parts, illustrated by a sufficient series of alcoholic preparations, and helped out by such individual teaching as can be given without weakening the habit of self-reliance. In this way he goes through group after group, until, from a study of about one hundred species, he has gotten a general idea of the organic forms above the Protozoa. In this stage of the student's work care is taken to avoid the use of diagrams; this avoidance being dictated by the conviction that the student remembers the diagram and not the object. During this year botany is also taught, with the same object and by much the same method. In connection with the zoological instruction the students are taught the elements of microscopy, the development of the subject being left to the next year.

The second-year courses are advanced zoology, palæontology, historical geology, geography, and advanced botany. The first two have one common feature; three lectures or readings are given each week to the discussion of the history of zoology and palæontology, with special reference to modern opinions concerning the relations of animals. An effort is made to acquaint the students with the character of the greater works in the science, by giving them constant opportunities for consulting them in their studies, and by showing them the methods of the masters in the several departments. Besides this, each student is required to pursue some special line of work. In the choice of subject the largest liberty is allowed, but the student is, however, recommended during a half-year to study advanced microscopy; in this work the aid of an instructor is given for four hours a week. In this four months he should acquire a sufficient knowledge of the practical management of the instrument in all ordinary investigations. The laboratory is well supplied with instruments of instruction in this branch of work.

Besides the course in the history of the science, the student who takes the elective in palæontology is required to traverse the ground covered in that part of "Dana's Manual" which is entitled historical geology, acquainting himself in a practical way with the most important characteristic fossils of the several periods.

The greatest value in this work is set upon the keeping of full and accurate note-books in both the last described courses. The rank of the student turns upon the condition of his note-books as much as upon the quarterly examinations which he is required to pass.

Those students who desire to contend for honours at the graduation in zoology or in palæontology are required to have taken, besides their junior election in natural history, one election in physical science, and at least three natural history elections in the senior year, in all of which they must have attained excellence. They are moreover required to write an acceptable thesis, which must contain an original discussion of some question in biological science. Hereafter the junior electives will consist of a course in anatomy and physiology, one in zoology, and one in botany; and the students in this as well as in the last year will be allowed to substitute for the themes required in other branches theses upon scientific subjects prepared under the direction of their instructor.

The natural history education of the scientific school has undergone a great change within a year; hitherto the students have worked with the professors of the several departments, giving their whole time to any speciality which they might select. This plan, admirably suited as it was to the needs of the trained student who had fitted himself in other schools for the work of a special department, was not adapted to the needs of those to whom this teaching was to fill the whole office of higher education. With the introduction of the doctor's degree into the plan of the school, it became necessary to make a change which has long been desirable, by fixing a definite scheme of general scientific instruction in place of the imperfect system which had hitherto prevailed. A three years' course has been arranged which secures to the student a broad view over the whole field of science, and the advantage which comes from a knowledge of the methods of research in use in its several branches. It gives to those persons who may not have the desire or the means to go through a regular college course a systematic training which will occupy their full time for three years, and give the best results of culture which can be attained in any scientific course. Students who can pass the required examinations are admitted to the degree of bachelor of science. Graduates of colleges where science is taught in an effective way should be able to enter this course in advanced standing. Students of the college, graduating with honours in the departments of natural history, should be able to obtain the degree in this course in a year of study. The student is trained in the important art of expressing himself clearly on the matters which he is studying, by requiring him to keep carefully planned note-books; and he is urged to the preparation of theses which may embody the results of some research. Ample opportunities are given for the prosecution of studies in the field, by excursions during term time and vacation, led by the instructors in zoology, botany, and geology.

After two years' further study, one of which must be spent in Cambridge, the student may apply for the degree of doctor of science, which is given after an examination conducted by a committee appointed by the Academic Council of the University.

The study done, the preparation for the degree must be in some special department, when the student will generally become the private pupil of some one professor. The degree will be a certificate of capacity as an investigator or teacher in the science which the student has made his specialty.

The resources of the University for teaching science are, it is believed, not only unrivalled in this country, but unsurpassed in Europe. The scientific departments have a list of twenty-four instructors, and the material resources which they afford have cost in the aggregate over a million and a half of dollars. There are six museums in the University—the Museum of Comparative Zoology, the Botanical Museum, the Museum of Comparative Anatomy, the Museum of Morbid Anatomy, the Museum of Mineralogy, and that of Ethnology. These collections are unsurpassed by those of any educational institution in this country; and, taken together, they furnish an efficient basis for the acquisition of the wide ranging knowledge on which a scientific career must be based. The opportunities for contact and intercourse in scientific societies are excellent. There is a working society of natural history in the University, and the Boston Society of Natural History, one of the largest and most efficient of the American institutions of this nature, is also open to all students of the science.