Chimborazo; but he proves, by his careful and elaborate observations, that, though they became somewhat habituated to low barometric pressures, their bodily powers were sensibly diminished. In his own case this appeared to begin at a pressure of about 21 inches (roughly, 10,000 feet above the sea). He comes to the conclusion that, after some habituation, life can be sustained, when the body is at rest, at a height of 20,000 feet or more; but "when in motion it becomes difficult to enlarge the breathing capacity to the extent necessary to meet the further demand for air which was the result of muscular exertion"[1]

During these laborious expeditions Mr. Whymper was constantly occupied in carrying out the other objects of his journey. The physical geography of the region was studied, sketch maps were constructed, and many specimens of rocks and volcanic dust were collected, especially from the higher points. The mountains (except Sara-urcu, the rocks of which are crystalline schists and gneisses) all consist of volcanic rocks, varieties of andesite. Cotopaxi and Sangai are still active; in some of the others, even the craters cannot be distinguished. The glaciers were carefully observed, for Mr. Whymper has proved that, contrary to the received statement, glaciers are by no means rare in the Ecuadorian Andes. Botanical and zoological collections were made, especially from the higher localities. Lichens were found as high as 18,400 feet, mosses to about 16,660 feet, grasses nearly as high, with a few Phanerogamous plants; the highest *Lycopodium* found was at 15,871 feet. *Coleoptera*, *Orthoptera*, *Rhynchota*, and *Lepidoptera* were all found at or a little above 16,000 feet, and *Arachnida* nearly as high. *Crustacea*, *Reptilia*, and *Batrachia* are rare; and Mr. Whymper could only obtain one fish (the noted *Cyclopium cyclopum*), which he does not believe to be ejected from Cotopaxi. These have been examined by various specialists, whose reports are summarized in the work, and some of them are collected in a supplementary volume, which will receive a separate notice. Mr. Whymper also made an interesting collection of stone implements and of ancient pottery, of which many specimens are figured. In one of the appendices he discusses the results of observations of mercurial and aneroid barometers. These, though of much interest, we must pass over.

In the space at our disposal it has been impossible to do justice to the varied topics of this volume. It must suffice to remark that Mr. Whymper has more than maintained the reputation which he won in his well-known "Scrambles among the Alps." The present work is admirably written, clear and terse in style, and often enlivened with a spice of dry humour. Of the illustrations it is almost needless to speak; they are even better than those in the former book. Some are delightful renderings of comic incidents; others represent stone implements, pottery, insects, and various examples of the Ecuadorian zoology; others are pictures of the mountain scenery, including the upper part of Chimborazo and the summit crater of Cotopaxi. The book, in short, is not only a record of pluck and endurance (for the hardships, lightly as they are treated by Mr. Whymper, were often great), but also a literary success, and a contribution to science of no small value.

T. G. BONNEY.

FIG. 3.—The contents of a grave.

FIG. 4.—"This is very old, Señor."

## *SCIENCE AT THE ROYAL MILITARY ACADEMY.*

MANY of our readers will have seen that on Thursday last Sir Henry Roscoe asked the Secretary of State for War whether the military authorities were aware that at present it is possible for a cadet at the Royal Military Academy to pass through the course of work required of him successfully, and even to win admission to the Royal Engineers, without gaining a fair elementary knowledge of any branch of experimental science, and whether Mr. Stanhope would investigate and remedy this evil.

We understand that this step has been taken by Sir Henry Roscoe because the disadvantageous position of cadets who have entered the Royal Military Academy with a knowledge of science as compared with the position of those who have offered a second modern language at the entrance competition,[1] makes it increasingly difficult to maintain science studies in the Army sides of public schools. It may also be expected before long to have the effect of seriously diminishing the proportion of officers in the scientific branches of the Army who have had the advantage of such a prolonged study of experimental science as was admitted to be desirable when this subject was discussed a few years ago.

The answer made by Mr. Stanhope was partly of a satisfactory character and partly not so. He undertook to investigate the subject to which his attention was

[1] I have never suffered (when otherwise in good health) from mountain-sickness in the Alps, but have often observed that I got "out of breath" more quickly in ascending peaks above 10,000 or 11,000 feet. This was especially noticed in an ascent of the Matterhorn, when, owing to threatening weather, I went as fast as possible up the last thousand feet or so.

[1] Usually, we believe, the second selection is German.

called. But, on the other hand, his reply reveals the fact that the educational authorities of the War Office still fail to see that science studies, like all other studies, must, in the case of the young, be somewhat prolonged in order to properly develop their value and render their effects permanent; especially if only a moderate portion of time can be devoted to them. For he stated that so far no cadet has gained admission to the Engineers without a fair knowledge of chemistry and physics. Now, as a good many of the cadets enter upon their work at Woolwich with little or no knowledge of these branches of science, as ten subjects are studied at the Royal Military Academy, and as the whole course of work only covers two years, it seems clear that the elementary knowledge in question must often be of a very elementary character indeed, however excellent the teaching may be, especially when it is remembered that some of the cadets doubtless have but little taste for such studies, and that the scientific faculties of these will have become more or less weakened by disuse during their previous course of training, which frequently has included no experimental science subject for several years.

The following are the circumstances of the case. The course of instruction at Woolwich occupies two years, which are divided into four terms. At the end of the second term, the choice of joining the Engineer Division is offered to the candidates in order of merit as indicated by the marks obtained in the first two terms. But no cadet can be posted to the Engineer Division who does not obtain 50 per cent. in fortification.

The marks for the obligatory subjects are:—

| | |
|---|---|
| Mathematics[1] ... ... ... | 3000 |
| Fortification ... ... .. ... | 2000 |
| Military Topography ... ... | 2000 |
| French *or* German ... ... ... | 1000 |
| Chemistry and Physics ... ... | 1000 |
| Model Drawing ... .. ... | 300 |

In addition, each cadet may take up a second modern language as a *voluntary subject* (in practice this is usually German), marks 1000—50 per cent. being the counting minimum; and landscape drawing is also a voluntary subject, marks 700, and counting minimum 50 per cent.

To count marks in any of the obligatory subjects, at least 25 per cent. of the total must be obtained.

For class promotion at the end of the first and second terms, candidates are required to obtain 50 per cent. of the marks in mathematics, and in at least three out of five obligatory subjects, and 50 per cent. of the aggregate.

Thus it appears that a candidate who had learnt no science at school might gain admission to the Royal Engineers in spite of failing in science at Woolwich.

Experience of this system as it works at the Royal Military Academy shows that in consequence of the very low minimum counting mark of science, even a beginner must be very dull or very idle to prevent him from counting the subject, especially as the teaching is suitable for beginners. Consequently, though chemistry and physics are nominally compulsory, anything beyond a very slight degree of proficiency is really a voluntary matter, especially as the effect of low marks in them can be compensated by marks obtained for a voluntary modern language by those who have offered two modern languages at entrance. The converse of this is not possible. For the voluntary modern language, in consequence of its high counting minimum mark, and in the absence of any really elementary teaching of the subject at the Royal Military Academy, cannot be made to count, as a rule, in the very limited time available, by those who have not taken it as one of their subjects at the entrance examination.

The result is that at the end of the second term those cadets who have taken two modern languages at the entrance competition may not only score a high mark for a voluntary language, but can also easily gain a helpful mark in science; whilst those who have taken up one modern language, and a branch of science, can only as a rule count marks in one subject at the later stage. As the competition for Engineers is very keen, the latter class are at a serious disadvantage. In short, the taking up of a second modern language at the entrance examination is made almost compulsory by the present system, much to the loss of those candidates whose abilities are greater in other subjects.

The state of things which we have endeavoured to make clear in a few words has only lately been realized by schoolmasters and parents, through the reports of former pupils and others who are familiar with the matter. The result has been that there is now often great pressure upon teachers to send up candidates with two modern languages, and no science for the entrance examination, even when they believe that to take up one modern language, and a branch of science would give the boy an equally good or better chance of gaining admission into Woolwich, and would be of far greater professional value to him afterwards. It is therefore certain that, unless it be shown that these views are wrong, or the conditions are amended, there will soon be a distinct diminution in the proportion of candidates offering science from the public schools.

The present situation is unfair to candidates whose abilities lie in the direction of science. It tends to keep out of the scientific branch of the Army the specially scientific candidates. It will tend, also, to keep boys from public schools out of the Army, and replace them by those who have resorted to Continental tutors. And finally, by discouraging the teaching of science in Army classes, it must make it increasingly difficult to maintain a high level of science work at schools generally. We therefore hope that those who are with us in this matter will take any steps they may be able, to secure that the opportunity created by Sir Henry Roscoe shall not be lost.

[1] 800 additional marks for higher mathematics, but cadets cannot count these papers if they do not obtain at least 40 per cent. of the marks.

## *THE LATE SIR WILLIAM BOWMAN.*

TO many of the readers of NATURE the distinguished man of science whose life was so unexpectedly brought to an end a little more than a fortnight ago, was best known as a great ophthalmic surgeon who for a long period of years occupied the first rank in his own line of professional work. But to those of us who are old enough to remember what physiology and anatomy were forty years ago, the name of Bowman has very different associations. It recalls to us a series of splendid anatomical discoveries communicated to the Royal Society between 1840 and 1850, of which the chief results were afterwards brought together in the great work which Bowman subsequently published in association with Dr. Todd on the "Physiological Anatomy of Man." In the following paragraphs I have endeavoured to give a sketch of the most important of these discoveries, in the hope that the many scientific friends to whom his memory is dear may find it, however imperfect, yet acceptable for his sake.

The three most important subjects of Bowman's researches were: (1) the structure of muscular fibre, (2) the structure of the kidney, and (3) that of the mucous membrane of the alimentary canal.

(1) *The Structure of the Fasciculus of Striated Muscle* (Phil. Trans., 1840).—It had been recognized that the fasciculus of striped muscle is made up of what Fontana designated as "*fils charnus primitifs*"; and much more recently