

greater number may be seized with the fingers with a little practice, and immediately plunged into a bottle of spirits of wine, or any other strong spirit; but many large ones may be boxed with large pill-boxes (of course, only one in each box), and at the end of the day may be suffocated with brimstone or chloroform, and then put into the spirit. Where a collector is collecting insects, he may catch many swift-running or strongly-jumping spiders by placing his open net in front and driving them into it with the other hand. A large umbrella is a first-rate implement for beating boughs or long herbage into.

4.—What to do with *Arachnida* after having caught and bottled them.

All that need be done is to put as many into a bottle as can be fairly got into it. There is no need to put large specimens into one bottle and small into another; for it is found practically that a judicious mixture of large and small is of no disadvantage, but rather the contrary.

One special point to be always observed is to fill up the bottle, where the specimens do not quite do so, with small bits of soft paper crushed up and gently inserted, until the contents fail to move about with the motion and shaking of the bottle.

The best bottles are $\frac{1}{2}$ oz. phials, 1 oz., 2 oz., and 4 oz. wide-mouthed ditto, all of which are kept in stock by chemists or bottle-makers in England. The smallest of these will hold a large number of small specimens, and the largest are large enough for all except a very few of the gigantic *Mygalidæ* and scorpions; for the latter it must be a barren region which will not furnish an empty pickle-bottle capable of holding some scores of the largest species. Tight corking is, of course, necessary, and in hot regions tying down of the corks.

Of course any notes on the sexes of species or their habits, &c. as well as on their colours, as these sometimes fade in spirits, are valuable; and where notes can be made, there should be a supply of test tubes of various sizes into which the example noted should be placed with a written card or letter, with a parchment number corresponding with the numbered note. The tube should then be filled with spirit and stopped firmly with a piece of cotton-wool, and placed *wool downwards*, in one of the wide-mouthed phials. A number of tubes may thus be packed into a phial, but spirits should also be always put into the phial as well as into the tube.

Where there is a fear of handling spiders of large size, or scorpions, a simple pair of forceps may be made of a piece of bent hoop-iron, rivetted at the bend through a piece of inserted tough wood, this gives sufficient spring to keep the digital joints always extended a little way. With these forceps *Arachnida* of a large size may be safely caught, or extracted from holes and crevices.

Mr. Bates' plan for killing the *Mygales* on the Amazons, was to get them into a tin pot or box, put the cover on, and place it for a few minutes upon the glowing embers of a charcoal fire. These means of killing may be used where neither brimstone nor chloroform are available.

From the above hints it will be seen that, compared to the trouble of collecting birds, mammals, or insects which require careful setting and drying, the trouble of collecting and preserving *Arachnida* is *nil*, and in all tropical regions an intelligent native would collect hundreds of specimens in a day if he were only furnished with two or three large bottles full of strong spirit.

Thus all that is necessary for the complete equipment of a collector of *Arachnida* is a large umbrella, a pair of forceps (such as are above described) about twelve inches long, two or three dozen of the bottles above-mentioned, a hundred or so of test-tubes of different sizes, a little cotton-wool, soft paper, and some strong spirit, which may be got on the spot nearly everywhere.

O. P. CAMBRIDGE

INTRODUCTORY LECTURE OF THE MURCHISON CHAIR OF GEOLOGY AT EDINBURGH, SESSION 1872-3*

BEFORE entering on the special subjects to be treated of in the following course of lectures, it is most desirable that we should definitely shape to ourselves the objects we have in view. By doing so we can the better take stock from time to time of our gains, and judge at the end how far we have succeeded in achieving any solid advantages.

Now, if I put the question frankly to you, What do you propose to accomplish by voluntarily placing yourselves under such a course of instruction as that which begins here to-day? you will, perhaps, reply that your desire is to know something more of a science which offers to your minds so many points of interest.

The task you have undertaken promises to be a pleasant one, and possibly all the more so since there may be a very general impression among my audience that your duties here will be rather an exercise of the memory than of the reasoning powers, and hence a not unwelcome relief from severer studies.

I should be sorry to dispel so pleasing a belief; on the contrary, it would give me some assurance that if our conjoint efforts fail the fault will lie with me, and not with you. Nevertheless, I have a deep conviction that, in seeking here merely an addition to your knowledge, you would neither do justice to the subject we are to study nor to yourselves.

I know only too well that the imparting of knowledge is popularly supposed to be the only aim and purpose of natural science teaching, and that this notion pervades our system of education. I believe it to be but a partial view of the truth; and even at the risk of being thought dull I would lay before you another view, that you may see what additional objects you may, in my opinion, accomplish here, besides storing your minds with facts.

No one who thoughtfully considers the state of public feeling in this country at the present time can doubt that we are on the eve of educational changes more momentous than any which have come to pass for centuries. It is not merely that education has become a political cry; that it forms a staple element in the declamations which fill the air from the halls of St. Stephen's to the village green; and that all this oratory finds further exposition and enforcement in the public prints. It is not merely that we believe it will be hard, a generation hence, to find a man or woman throughout the land who cannot at least read and write. These results, profoundly important as they are, do not fill up the whole measure of change which is impending, nor are they those which most nearly concern you and me at present.

It is impossible that such radical reforms should be worked in the primary education of the country without an influence, and perhaps an extremely potent one, upon the higher forms of culture. On every side, indeed, we can already descry indications of the coming changes—changes, however, which are not wholly, nor even, perhaps, chiefly, due to the disturbances of our primary educational system, but which would assuredly have been brought about, even had no sweeping Parliamentary legislation taken place.

Nowhere can these indications be more significantly seen than among those conservative educational centres, where it might have been supposed that the call for reform would have been longest in making itself heard and obeyed. Even there the old and time-honoured traditions are losing their hold. The young blood of a newer time has begun to quicken some of the most dormant of our institutions.

Uncompromising opposition is apt so to embitter a struggle, that what is at first only a desire for reform partakes in the end somewhat of the blind fury of a revolution.

* Given on Nov. 11 by Prof. Geikie, F.R.S.

It is, however, a happy omen for the future of higher education among us that some of the most strenuous champions of change are to be found among those whose vested interests and traditions might have been deemed likely to ensure their conservatism. These men are not in much danger of going too far, and yet their earnestness is a guarantee that they certainly have no intention of standing still. The foundations on which the culture of centuries has been built are not to be ruthlessly pulled up; but the time has assuredly come when they need to be broadened and widened.

Let no one imagine that such words as these imply any want of reverence for the time-honoured means of mental discipline. Literature and philosophy have ever taken, and must ever take, the foremost place in intellectual culture. They bring mind in contact with mind, and with all that is highest and noblest in the history of humanity. There was a time, indeed, when they comprised the whole sum of human thought. That time has long passed, and yet, in our traditional system of education, we still perpetuate its memory. But man has since then discovered that, although he be indeed a marvellous microcosm, there lies outside of him a great world full of infinite diversity wherein he can, nevertheless, discover such a unity of plan as links even his own being with every part of nature.

It is not now enough that man shall know what his forefathers have thought, or written or done, nor that he shall content himself with studying the nature and workings of his own mind, or busy himself with abstract principles of magnitude and number. Now why is this so? Because during the last two hundred years his relations to the external world have been so thoroughly altered. He is no longer a mere higher kind of animal, ignorant almost as other animals of the phenomena in progress around him, and well-nigh as helpless as they in the inevitable struggle with the elements. For thousands of years he had aspired to rule over but one, and that the least, of the domains of which he was made lord at the beginning:—he was content with undisputed dominion over the beast of the field, and the fish of the sea, and the fowl of the air. He has now claimed the right which was his by the same charter to have dominion over the earth and to subdue it. So that now his mastery is hardly less decisive over air, and land, and sea. He can bend the energy of nature to do his humblest offices.

What is it, then, which has made this difference between man's power in this present time and that which he possessed only a few generations ago? Can you trace it to the teaching of the schools? Is it the fruit of that traditional system handed down to us from older centuries? Assuredly not, it has sprung from a sphere of education outside of the schools. It is to be traced, without doubt or cavil, to the strides which modern physical science has taken. Man has gone to school elsewhere than in the class-rooms. He has proved himself too, to be an apt pupil, for in the comparatively short space of time in which he has given himself to these pursuits, he has gained such a mass of knowledge as has enabled him to work greater changes on the face of the globe and on his own relations to it than had been effected during all the previous centuries put together.

By this wide-spread dominion over nature we stand separated by a kind of gulf from our forefathers. And yet strange as it may seem, we have made no corresponding change, in the range of subjects which are still prescribed for the higher education of the country. We send our young men and young women to be trained very much in the same modes which were in use a couple of centuries ago or more. We live in the days of railways and telegraphs, and we educate our youth as if they lived before the introduction of mail-coaches.

It is true that both in the higher schools and colleges, certain supplementary subjects, of which natural science is one, may be taken at the option of the learner. But

these subjects are not made essential parts of our higher education, nor does any provision exist for making them more than mere sources of information. They are not in any way made use of as implements of intellectual training. And even the use to which they are put is so slight that a man may attain the highest academic honours and yet remain as ignorant as a school-boy of the commonest facts and phenomena around him, and of the causes which make his own age to differ so profitably from the ages which have gone before it.

I remember being much impressed with this fact, when as a boy, I met among the hills of Skye, a man who had not long taken his Master's degree at Cambridge and who had retired to that remote region for the purposes of further study. We happened to get into conversation regarding the origin of the mild climate of the north-west of Scotland. On being questioned, I referred to the influence of the Gulf-stream. My friend, however, had never heard of a Gulf-stream, refused to believe it to be more than one of what he called my "geological speculations," and would hardly even credit the school-master, who, when appealed to, gravely assured him that he had heard of the Gulf-stream before I was born.

This may be an extreme case, but it is an actual one. It serves to show that though a man can hardly fail to pick up some acquaintance with science in the course of ordinary conversation or in reading the current literature of the day, no provision exists for making instruction in the meaning of the ordinary every-day facts of nature a necessary part of education, and that a man may gain his academic honours even without such instruction.

I am well aware that in one way or other a smattering of at least one science, sometimes a confused jumble of several, is very commonly carried away from school. The science-classes there, though they may be wholly optional, are often also popular with the scholars. Interesting experiments, pretty specimens and amusing diagrams are exhibited, and some amount of information is communicated, even if no special interest should be awakened in the subject, and no clear mental gain should be the result. But this is far from the sort of position which, as it seems to me, science ought to hold in higher education.

If culture is to be really liberal, that is, free and generous, surely it ought above all things to reflect fully and fairly the spirit and character of the time. If it shuts out this influence and continues to maintain the standard fixed for a wholly different time, does it not cease to be truly liberal? Full of reverence for the past, and striving after the fullest use of the heritage of wisdom which the past has bequeathed, a liberal culture, to be worthy of the name, must recognise that no standard however serviceable for the time in which it was erected, can be permanent; and that the limits which it sets for its own age cannot bind the ages to come. For the laws of continuity and evolution embrace the workings of the human mind as well as the operations of outer nature. And in the end it will be as impossible to keep the flow of youthful thought confined in one narrow and old-fashioned channel as it would be to restrain the river which is every moment rising to overflow its banks.

No great foresight is needed, therefore, to perceive that before many years are past the stereotyped curriculum for what is called a liberal education, whether in higher schools or in the universities, must be modified. It is not enough that a young man or a young woman should be permitted a choice as to the acquiring of some knowledge of science beyond that needed for the old standard. This knowledge, but still more the intellectual training by which it was originally obtained, should be an essential part of any system of education truly deserving now-a-days the name of liberal. And the want of this training should be regarded as quite as serious a defect in education as an ignorance of Latin or mathematics.

(To be continued.)