

children to observe facts, and lead them gradually from simple facts to the more obvious and easily understood laws of Science. Such classes are formed in Germany, in what are called *Real Schule*, and the system has been introduced into England under the name of Object lessons. Such teaching might be preparatory to taking up any one branch of Science, such as Chemistry, Experimental Physics, Botany, or the elements of Human Physiology.

We are glad to find that this subject has again been taken up by the British Association for the Advancement of Science. A few days ago a deputation of this Association waited on the Vice-President of the Council for the purpose of presenting a memorial on scientific teaching in elementary schools. Their reasons for urging this subject, they say, are three: "Firstly," the memorial says, "we conceive such teaching to be one of the best instruments of education in the sense of intellectual discipline, and in many respects better calculated to awaken intellectual activity than other studies; secondly, we think that a knowledge of the elements of Natural Science has a high value as information; and thirdly, we are of opinion that scientific training and teaching in the elementary schools will afford the best possible preparation for that technical education of the working classes, which has become indispensably necessary to the industrial progress of the country." The subjects they propose to be taught are elementary Physical Geography, elementary Physics and Chemistry, elementary Botany, and elementary Human Physiology. They think that by such an education the children of "the poor and necessitous" might be prepared to take advantage of the scholarships and exhibitions which are now only open to the children of the well-to-do classes of society.

E. LANKESTER

THE LEARNED SOCIETIES AND THE PRESENT CONDITION OF SCIENCE AND LEARNING

THE appointment of the Royal Commission on the present condition of Science will naturally turn the attention of many minds to the subject, and its discussion will certainly elicit many suggestions and schemes for the better culture of knowledge. The question is so large, so important, and so difficult, that the freest possible discussion will be necessary for its satisfactory solution.

At present we wish to direct attention to the question as to how we may obtain from the Learned Societies of the United Kingdom the greatest possible aid in the improvement of natural knowledge. The number of these societies is now large. Some of the provincial societies can claim an honourable place even when compared with the associations which are not confined to any one locality in their choice of members. Members of the Literary and Philosophical Society of Manchester, it should be remembered, were the first who were favoured with Dalton's Atomic Theory. Of what we may call the national societies, the number is increasing yearly, greatly to the detriment of real progress. Membership in these societies is coveted because it is supposed to indicate the possession of certain acquirements, it being thought, not unnaturally, that the members have won their spurs as investigators

and interpreters of Science. Nor can we conceive of any better tests than those at present applied to candidates. Examinations are clearly impossible in this case, even if one were fully confident of the certainty of that method for detecting ability. It is evident that, on the whole, the regulations now enforced have been successful in their object, and that membership of a British Learned Society is generally not only a coveted distinction, but one deservedly prizeable.

Year by year these societies gather up the result of patient investigations, of long and careful research. Recording new facts, illustrating old truths, dissecting error, they pursue a course of steady consistent usefulness. Every one who has had to work up some special topic, must have a feeling of gratitude for the aid he has received from their publications. The societies are doing a good share of honest work, and doing it well. Their ranks include the most distinguished and the most ardent investigators in each branch of learning. Still we need not attempt to disguise the fact that they do not contribute so largely to the advancement of knowledge as it is desirable they should do. They have forgotten, or never known, that unity gives strength. They have neglected the great fact, daily becoming more apparent, of the unity of knowledge.

"The divisions which we establish between the Sciences are, though not arbitrary, essentially artificial. The subject of our researches is one: we divide it for our convenience, in order to deal the more easily with its difficulties. But it sometimes happens—and especially with the most important doctrines of each Science—that we need what we cannot obtain under the present isolation of the Sciences,—a combination of several special points of view; and for want of this, very important problems wait for their solution much longer than they otherwise need do. To go back into the past for an example: Descartes's grand conception with regard to analytical geometry is a discovery which has changed the whole aspect of mathematical science, and yielded the germ of all future progress; and it issued from the union of two Sciences which had always before been separately regarded and pursued." (Comte.)

Science suffers not only from the causes indicated in the preceding extract, but also from the dispersion of material in different receptacles, all of which are not accessible to the student. If the number of existing learned bodies be taken into consideration, and also their conflicting claims, it will be obvious that none except rich men can possess all the aid which they can give to the investigator. A paper upon the characteristics of one of our English dialects might appropriately be read before the Royal Society, the Society of Antiquaries, the Philological Society, the Archæological Institute, the Archæological Association, the Royal Society of Literature, the Ethnological Society, the Anthropological Society, and a score or more of the provincial societies. We find a valuable monograph on the Lancashire dialect in the Proceedings of the Philological Society, and another in the Transactions of the Literary and Philosophical of Liverpool, but for information on the eastern variety of that dialect, we must go to the Historic Society of Lancashire and Cheshire. The Cheshire glossary must be sought in the *Archæologia*, the Cumbrian in the Royal Society of Literature.

The same confusion may be predicated of almost every subject that can be taken up for inquiry. And, in spite of the multiplicity of societies, there is greatly needed throughout the length and breadth of the land a network of intelligent observers. We propose, as a remedy, that the present chaotic want of system be superseded by a National Institute for the Advancement of Knowledge. Such an institute might readily be obtained by the amalgamation of the present societies into one homogenous body. Whatever of interest and of value British savants might bring before it would be welcome and appropriate, and would be accessible to the student of the "knowledge which is one." In its organisation, the first labour would be the classification into sections. Whilst, on the one hand, there would not be three or four sections to perform the same work, on the other hand the entire domain of human knowledge could be fairly occupied, which is not the case at present, and the divisions marked with much greater accuracy than is now possible. The members residing in each district would form a local section, hold their meetings at regular intervals, and be a committee charged to watch over and promote the interests of Science and Learning in their particular neighbourhood.

In this brief and necessarily imperfect outline, much is omitted. Advantages not here indicated would result from the creation of a National Institute for the Advancement of Knowledge, but it is hoped that enough has been said to prove the desirability of such a foundation, having for object the attainment (in the words of Bacon) of "the knowledge of causes and secret motions of things; and the enlarging of the bounds of humane empire to the effecting of all things possible."

WILLIAM E. A. AXON

PROF. BALFOUR STEWART'S ELEMENTARY PHYSICS

Lessons on Elementary Physics. By Balfour Stewart, LL.D., F.R.S. (London: Macmillan and Co.)

THIS is a bold experiment, and decidedly deserves to be a successful one. Nearly all our elementary works, even on mere *departments* of Physics, are extremely bad, especially the so-called "original" ones; and those which have been translated from the French are little suited to the genius of this country—however excellent they may be in France—while they are usually spoiled by inaccurate translation, or by clumsy and injudicious addition of a mere cobbling or patching kind.

The reasons are not far to seek. It is very rarely that we find in this country a genuine scientific man who can, like Faraday or Herschel, make himself easily intelligible even on difficult subjects to an ordinary reader; still more rarely that we find such a man to have paid special attention to the merest elements of his subjects as to thoroughly understand them himself, which ought to be regarded as an absolutely indispensable preliminary to his teaching them to others. Take for instance the question of the measurement of temperature in conjunction with the second law of thermodynamics, that very second law itself, or its connection with the equality of radiating

and absorbing powers. Take even a simpler matter, the notion of a standard pound as a definite quantity of matter, not as something which shall be attracted by the earth with a certain force. Try all the elementary works in succession, and, if you are not driven mad by their inconsistencies and want of definiteness, endeavour to give in a clear, intelligible form the result of your studies on any such questions as those just mentioned. If you had no notion to begin with, you will have none, or worse than none, at the end; and, even if you began with thorough knowledge, you would probably end helplessly confused, doubting the simplest and most obvious truths. But this is the way we do things at home; and hard, indeed, must be our British heads, which, after they have managed our "*As in presenti*," &c. &c., can plunge into this further chaos, and rise, as they often do, refreshed and invigorated by the struggle. A Frenchman, perhaps even a German, would perish in the attempt. But for them the path is made comparatively easy.

Nothing seems plainer than this—that he who has been ill-taught in the elements of his subject, however he may advance in knowledge (which is always a man's *own* work, whoever be his teacher), can hardly hope to understand these elements well enough to teach them to others. They have become to him a hateful thing, so he pushes on and avoids them as much as possible. Hence, that we may have really elementary works of a strictly scientific kind, we must have, not merely a genuine scientific man to write them, but one whose elementary instruction was good, or one whose strength has enabled him to get over its imperfections. These qualifications are certainly united in Dr. Stewart, for he had the late Principal Forbes for his teacher, and he is himself a man of quite exceptional powers, both in experiment and in reasoning.

It is scarcely possible to form a judgment as to the probable success of the present work. It is so utterly unlike anything to which we have been accustomed, that we can only say we never saw such a work, in English, at all events. Nothing so perfectly elementary, and yet throughout so intensely suggestive, have we ever met with. Even while reading the introductory chapters, we have several times laid down the book to follow trains of reasoning suggested by a single happy phrase that showed us something with which we had considered ourselves familiar, from a perfectly novel and interesting point of view. This, of course, will not strike the beginner, neither will it impede his progress; for it is not learned and abstruse disquisition or discussion, it is simply the clear vision of the writer.

Dr. Stewart does us much more than justice in the Preface, for he exaggerates the importance of a few suggestions of ours, made only with the view of keeping him to *his own plan*, which we consider to be an admirable one. The grand modern ideas of Potential and Kinetic Energy cannot be too soon presented to the student; he ought to be familiarised with them as soon as he commences the study of Physics. In fact, we believe that before many centuries have passed, perhaps before fifty years have elapsed, the word Force will have become as much a nuisance and an impediment to the beginner in Physics as the phrase Centrifugal Force is already.

However this may be, the work before us is an excellent one, and will certainly (*if there be teachers found sufficiently*