

Meteorological Office has received the special thanks of the Admiralty for its services in the Mediterranean. The world at large has been unaware of these manifold activities, imagining that the Meteorological Office practically ceased to exist when the daily forecasts in the newspapers came to an end. Yet during its silence the department has been worked far harder than ever before, and it was in recognition of the success of the service that the director received the honour of knighthood.

#### EDUCATION AT THE BRITISH ASSOCIATION.

AFTER the presidential address, the section took up the discussion of the reform of the primary school. Mr. J. C. Legge dealt with handwork, but unfortunately he spent the greater part of his half-hour upon historical and psychological preliminaries. Of the constructive suggestions outlined in the abstract the most interesting was the idea of finding in the soldiers returned from the war a great reservoir of admirable men who might be trained as teachers of handwork. He concluded with a plea for greater freedom to local authorities, a freedom such as would allow them to develop along their own lines, under the gentlest supervision from a very human central authority. Prof. T. P. Nunn pointed out the dangers of formality in handwork—a danger from which Mr. Legge's paper was not wholly free, in so far as it seemed to separate the activity of muscle and nerve from purposefulness. Manual activity must not be regarded as an end in itself, a danger which it shared with all other school subjects, as shown especially by mathematics and geography. Some body of central interest, life itself perhaps, is essential in order to give meaning to the several parts of the curriculum. In school, handwork should be an aid to the so-called intellectual subjects, and it should be the means of developing the feeling for craftsmanship and art. Prof. J. A. Green pleaded for a larger place and a new use for books. The bookiness of the primary school was not due to a superfluity of books, but to the unrealities for which books stood. Rightly understood, it is more books, not fewer, that are wanted there. A disappointing discussion followed, in which side-issues rather than fundamentals were raised—a result perhaps inevitable when the wide range of the subject is remembered.

A better result was achieved next day, when the place of science in secondary and higher education was considered. Mr. J. S. Talbot, referring to a committee of the Incorporated Association of Headmasters which had met recently at Wellington, said there was general agreement as to the necessity of finding a place for science amongst the subjects essential to a good school education. From two and a half to four hours a week should be provided for it in the school time-table of all boys up to sixteen. At the same time, they were not agreed that the school science of to-day was wholly satisfactory. A well-educated boy should surely know something of men like Newton, Darwin, and Pasteur, though he might now do much science at school without hearing of them. Dr. Gray's precise scheme of reform followed broadly the same line. The division between classical and modern sides should, he thought, be dropped for all boys in public schools before sixteen, though the division might take place at fourteen in municipal secondary schools, where it would follow technical and commercial lines of demarcation. After sixteen all boys should be taught the principles of biology. Dr. Hadow dealt with the subject from the point of view of the universities. The present first-year work might

be better done in the schools, and the three years' university course begin at the end of what is now the intermediate course. As to research, the pure science student might start immediately he had graduated, but applied science men should go to the works first and return to the university after a year or two there. Dr. E. F. Armstrong deprecated the booky man of science. Present methods produced few men of any use in business where scientific methods of attacking problems were the first essential. But the prizes in industry depended in the last resort upon capacity for organisation and command. In the discussion, all the speakers agreed in condemning early specialisation and demanding a fuller recognition of science in the schools, and some further emphasis was laid upon the doubt as to whether just the right kind of science was being provided for boys amongst whom a large proportion had literary or linguistic tastes. Similar problems in relation to girls' education were discussed in the afternoon, though the issues were narrowed down to the school science more suited to girls preparing for the medical profession on one hand, and for domestic life on the other.

The last meeting of the section was devoted to a consideration of the report of the Mental and Physical Factors Committee, which had conducted an inquiry into the development of facility in the first four rules of arithmetic as shown by elementary-school children between eight and fourteen years of age.

#### THE BRITISH ASSOCIATION AT NEWCASTLE.

##### SECTION K.

##### BOTANY.

OPENING ADDRESS (ABRIDGED) BY A. B. RENDLE, M.A., D.Sc., F.R.S., PRESIDENT OF THE SECTION.

SINCE our last meeting the Great War has continued to hold chief place in our lives and thoughts, and in various ways, and to a greater or less degree, has influenced our work. In the case of many botany has had for the time being to be set aside, while others have been able to devote only a part of their time to scientific work. On the other hand, it is gratifying to note that some have been able to render helpful service on lines more or less directly connected with their own science. The trained botanist has shown that he may be an eminently adaptable person, capable, after short preparation on special lines, of taking up positions involving scientific investigation of the highest importance from the points of view of medicine and hygiene.

Some months ago the various sectional committees received a request to consider what could be done in their respective sections to meet problems which would arise after the war. Your committee met and discussed the matter, with the result that a set of queries was sent round to representative botanists asking that suggestions might be presented for consideration by the committee. A number of suggestions were received of a very varied kind, indicating that, in the opinion of many botanists at any rate, much might be done to utilise our science and its trained workers in the interests of the State and Empire. Your committee decided to arrange for reports to be prepared on several of the more important aspects by members who were specially fitted to discuss these aspects, and these will be presented in the course of the meeting. These reports will, I am convinced, be of great value, and may lead to helpful discussion; they may also open up the way to useful work.

For many of us this means the breaking of new ground. We have taken up the science because we loved it, and if we have been able to shed any light on its numerous problems the work has brought its own reward. But some of us have on occasion been brought into touch with economic problems, and such must have felt how inadequate was our national equipment for dealing with some of these. In recent years we have made several beginnings, but these beginnings must expand mightily if present and future needs are adequately to be met, and if we are determined to make the best use of the material to our hand.

Without trenching on the domain of economics, we may assume that increased production of foodstuffs, timber, and other economic products will be desirable. The question has been raised as to the possibility of increasing at the same time industrial and agricultural development. But as in industry perfection of machinery allows a greater output with a diminished number of hands, so in agriculture and horticulture perfection of the machinery of organisation and equipment will have the same result.

The improvement of the plant from an economic point of view implies the co-operation of the botanist and the plant-breeder. The student of experimental genetics, by directing his work to plants of economic value, is able, with the help of the resources of agriculture and horticulture, to produce forms of greater economic value, kinds best suited to different localities and ranges of climate, those most immune to disease and of the highest food-value. Let the practical man formulate the ideal, and then let the man of science be invited to supply it. Much valuable work has been done on these lines, but there is still plenty of scope for the organised Mendelian study of plants of economic importance.

The introduction of new plants of economic value is within the range of possibility; our repertoire has increased in recent years, but an exhaustive study of food plants and possible food plants for man and stock would doubtless yield good results.

We have heard much lately as to the growing of medicinal plants, and experience would indicate that here is opportunity for investigation, and, unless due care is taken, also danger of waste of time, money, and effort. A careful systematic study of species, varieties, and races is in some cases desirable in order to ensure the growth of the most productive or valuable plant, as in the case of the Aconites; and such a study might also reveal useful substitutes or additions. Here the co-operation between the scientific worker and the commercial man is imperative.

The advantages arising from a closer co-operation between the practical man and the botanist is illustrated by the research laboratories recently organised by the Royal Horticultural Society at Wisley. Such an institution forms a common meeting-ground for the grower of plants and the botanist. The former sets the problems, and the latter takes them in hand under conditions approaching the ideal and with the advantages of mutual discussion and criticism. Institutions such as these will give ample opportunity to the enthusiastic young botanist who is anxious to embark on work of investigation. The student of plant physiology will find here work of great interest. The grower has perforce gained a great deal of information as to the behaviour of his plants under more or less artificial conditions, but he is unable to analyse these conditions, and the co-operation of the physiologist is an invaluable help. Experiments in the growth of plants under the influence of high-tension electricity are at the present time being carried out at Wisley. Such experiments may be conducted anywhere where land and power are available, but it is

obviously advantageous that they should be conducted by an expert plant physiologist versed in scientific method and not directly interested in the result. Dr. Keeble's recent series of lectures on "Modern Horticulture" at the Royal Institution deal with matter which is full of interest to the botanist. For instance, he shows how the work of Continental botanists on the forcing of plants has indicated methods, in some cases simple and inexpensive, which have proved of considerable commercial value, and that there is evidently scope for work in this direction, which, while of interest to the plant physiologist, may be also of general utility.

The subject of the soil offers problems to the botanist as well as to the chemist and proto-zoologist. In the plant we are dealing with a living organism, not a machine; and an adequate knowledge of the organism is essential to a proper study of its nutrition and growth.

The study of manures and their effect on the plant should attract the botanist as well as the chemist. In this connection I may refer to Mr. Martin Sutton's recent work at Reading on the effects of radium-active ores and residues on plant-life. A series of experiments was carried out in two successive years with various subjects selected for the different character of their produce, and including roots, tubers, bulbs, foliage, and fruit. From the immediate point of view of agriculture and horticulture the results were negative; the experiments gave no hope of the successful employment of radium as an aid to either the farmer or gardener. But, though the immediate result was unsatisfactory to the grower, there were several points of interest which would have appealed to the botanist who was watching the course of the experiments, and, if followed up, might throw light on the effect of radium on plant-life and lead in the end to some useful result. As Mr. Sutton points out, many of the results were "contradictory," while a close examination of the trial notes, together with the records of weights, will furnish highly interesting problems. For instance, there was evidence in some cases that germination was accelerated by the presence of radium, though subsequent growth was retarded; and the fact that in several of the experiments plants dressed with a complete fertiliser in addition to radium have not done so well as those dressed with the fertiliser only may be regarded as corroborating M. Truffaut's suggestion that radium might possess the power of releasing additional nitrogen in the soil for the use of plants, and that the plants in question were suffering from an excess of nitrogen. Certain remarkable variations between the duplicate unmanured control plots in several of the experiments led to the suggestion that radium emanations may have some effect, apparently a beneficial one. I have quoted these experiments as an example of a case where the co-operation of the botanist and the practical man might lead to useful results, and at the same time afford work of much interest to the botanist.

The utilisation of waste lands is a big subject and trenches on the domain of economics. But important botanical problems are involved, and careful ecological study will prepare the way for serious experimental work. The study of the growth of plants in alien situations is fraught with so many surprises and apparent contradictions that successful results may be looked for in most unlikely situations.

The study of the diseases to which plants are liable, and their prevention and cure, offers a wide and increasing field for inquiry, and demands a larger supply of trained workers and a more definite and special system of training. For the study of those which are due to fungi it is obviously essential that a thorough general knowledge of fungi and laboratory

methods should be acquired, preferably at some pathological institution which would also be in touch with the cultivator and naturally approached by those requiring advice and help in connection with disease, on the same principle that a medical school is attached to a hospital. An important part of the training should be the study of the disease in the field and the conditions under which it arises and flourishes. From the point of view of mycology much useful scientific work remains to be done on the life-history of the fungi which are, or may be, the causes of disease. Other plant diseases afford problems for the physiologist, who is a necessary part of the equipment of the Pathological Institute.

The anatomical and chemical study of timbers might with advantage occupy a greater number of workers. The matter is of great economic importance. Questions of identity are continually arising, and in the present vague state of our knowledge it is often difficult or impossible to give a satisfactory answer. Samples of timber are put on the market shipped, say, from West Africa under some general name such as mahogany; the importer does not supply leaves and flowers for purposes of identification, and in the present incomplete state of our knowledge it is often impossible to make more than a vague attempt at determination. Or a merchant brings a sample which has been sent from X as Y, which it obviously is not; but what is it, whence does it probably come, and what supply of it is likely to be forthcoming? These are questions which it would be useful to be able to answer with some greater approach to accuracy than at present. And it should be the work of definitely trained persons.

The various illustrative suggestions which I have made would imply a close co-operation between the schools of botany and colleges and institutions of agriculture, horticulture, and forestry; to pass from the former to one or other of the latter for special work or training should be a natural thing. While on one hand a university course is not an essential preliminary to the study of one or other of the applied branches, the advantages of a broad, general training in the principles of the science cannot be gainsaid. The establishment of professorships, readerships, or lectureships in economic botany at the university would supply a useful link between the pure and applied science, while research fellowships or scholarships would be an incentive to investigation.

There is the wider question of a *rapprochement* between the man of science and the commercial man. Its desirability is obvious, and the advantages would be mutual; on one hand it would secure the spread and application of the results of research, and on the other the man of science would be directed to economic problems of which otherwise he might not become cognisant. The closer association between the academic institution and those devoted to the application of the science would be a step in this direction.

Our British possessions, especially within the tropics, contain a wealth of material of economic value which has been only partially explored. One of the first needs is a tabulation of the material. In the important series of Colonial floras incepted by Sir Joseph Hooker, and published under the auspices of Kew, lies the foundation for further work. Consider, for instance, the "Flora of Tropical Africa," now rapidly nearing completion. This is a careful and, so far as possible with the material at hand, critical descriptive catalogue of the plants from tropical Africa which are preserved in the great British and European herbaria. The work has been done by men with considerable training in systematic work, but who know nothing at first hand of the country the vegetation of which they are cataloguing.

Such a "Flora" must be regarded as a basis for further work. Its study will indicate botanical areas and their characteristics, and suggest what areas are likely to prove of greater or less economic value, and on what special lines. It will also indicate the lines on which areas may be mapped out for more detailed botanical exploration. That this is necessary is obvious to any botanist who has used such a work. A large proportion of the species, some of which may, on further investigation, prove to be of economic value, are known only from a single incomplete fragment. Others, for instance, which may be of known economic value, doubtless exist over much larger areas and in much greater quantity than would appear from the "Flora." The reason of these shortcomings is equally obvious. The collections on which the work is based are largely the result of voluntary effort employed more or less spasmodically. The explorer working out some new route, who brings what he can conveniently carry to illustrate the plant products of the new country; the Government official or his wife, working during their brief leisure or collecting on the track between their different stations; the missionary or soldier, with a penchant for natural history; to these and similar persons we are largely indebted for additions to our knowledge of the plant-life. Advantage has sometimes been taken of a Government expedition to which a medical man with a knowledge of, or taste for, natural history, or, in rare cases, a trained botanist, has been attached.

It is time that pioneer work gave place to systematic botanical exploration of our tropical possessions and the preparation of handy working floras and economic handbooks. Work of botanical exploration should be full of interest to the young botanist. But if he is to make the best use of time and opportunity he must have had a proper course of training. After completing his general botanical course, which should naturally include an introduction to the principles of classification, he should work for a time in a large herbarium and thus acquire a knowledge of the details of systematic work and also of the general outlines of the flora of the area which he is to visit later. He should then be given a definite piece of work in the botanical survey of the area. From the collated results of such work convenient handbooks on the botanical resources of regions open to British enterprise could be compiled. There will be plenty of work for the systematist who cannot leave home. The ultimate elaboration of the floristic work must be done in the herbarium with its associated library. There is also need of a careful monographic study of genera of economic value which would be best done by the experienced systematist at home, given a plentiful supply of carefully collected and annotated material. Closely allied species or varieties of one and the same species may differ greatly in economic value, and the work of the monographer is to discover and diagnose these different forms and elucidate them for the benefit of the worker in the field.

If we are to make the best use of our resources botanical research stations in different parts of the Empire, adequately equipped and under the charge of a capable trained botanist, are a prime necessity. We seem to have been singularly unfortunate in the management of some of our tropical stations and botanical establishments.

A botanical station for research to be effective must be under the supervision of a well-trained botanist with administrative capacity, who must have at his disposal a well-equipped laboratory and ground for experimental work. The director will be ready to give help and advice on questions of a botanical nature arising locally, and he will be on the look-out for local problems which may afford items of botanical research

to visiting students. Means must be adopted to attract the research student, aided, if necessary, by research scholarships from home. The station should have sufficient Imperial support to avoid the hampering of its utility by local prejudice or ignorance. The permanent staff should include a mycologist and a skilled gardener.

Finally, I should like to suggest the holding of an Imperial Botanical Congress at which matters of general and special interest might be discussed. The visit of the British Association to Australia was, I think, helpful to the Australian botanists; it was certainly very helpful and of the greatest interest to those coming from home. Many of the addresses and papers were of considerable interest and value, but of greater value was the opportunity of meeting with one's fellow-workers in different fields, of conversation, discussion, and interchange of ideas, the better realisation of one's limited outlook, and the stimulus of new associations. A meeting which brought together home botanists and botanical representatives from oversea portions of our Empire to discuss methods of better utilising our vast resources would be of great interest and supremely helpful. Let us transfer to peace purposes some of the magnificent enthusiasm which has flowed homewards for the defence of the Empire in war.

In this brief address I have tried, however imperfectly, to indicate some lines on which botanists may render useful service to the community. To a large extent it means the further development and extension of existing facilities added to an organised co-operation between botanists themselves and between botanists and the practical and commercial man; this will include an efficient, systematic cataloguing of work done and in progress. We do not propose to hand over all our best botanists to the applied branches and to starve pure research, but our aim should be to find a useful career for an increasing number of well-trained botanists and to ensure that our country and Empire shall make the best use of the results of our research. Incidentally there will be an increased demand for the teaching botanist, for he will be responsible for laying the foundations.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

By invitation of the college authorities, the next annual meeting of the Association of Public School Science Masters will be held at Eton on Wednesday and Thursday, January 3 and 4, 1917, under the presidency of Prof. H. H. Turner. After the president's address the main subjects of discussion and their openers will be as follows:—Science for the rank and file, Prof. R. A. Gregory; Technical bias in science teaching in schools, Mr. E. R. Thomas; The place of the text-book in science teaching, Mr. G. N. Pingriff. There will be the usual exhibition of apparatus, but it will consist chiefly of exhibits by members of the association.

THE current issue of the *Fortnightly Review* contains an article by Dr. R. Brudenell Carter on "Science and Education." The subject is made interesting to the general reader from the variety of aspects under which it is viewed, and the interest is enhanced by literary style and historical illustration. The importance of early sense-training is emphasised, and attention is directed to the value of a pocket magnifying-glass as a child's possession. The author's views on the development of intelligence, individual and racial, appear at times to challenge orthodox genetic psychology, but this may be due to the difficulty of popular exposition in a short article. However this may be,

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general assent will be given to the proposition that instruction in science should "change the view taken by the pupils of the events around them, and produce a conviction of ignorance of many forces and conditions by which the lives of nations, as well as of individuals, are liable to be powerfully or overwhelmingly influenced." Dr. Carter's proposals for science instruction in schools will scarcely be accepted as adequate, even as part of the all-round instruction of those who do not intend to pursue a scientific career, since they depend upon lectures alone, a course which teaching experience has proved to be ineffective unless a period of practical and more intensive study is added. But science teachers will welcome the general trend of the article, and all readers will gain by the freshness and vigour of the essay. Even now our legislators need to be reminded that "wisdom is hardly to be expected from men who regard its highest manifestations with the unseeing eyes of the scientifically ignorant."

THE Mathematical Association has now expressed its agreement with the Classical, English, Geographical, Historical, and Modern Language Associations in the view that any reorganisation of our educational system should make adequate provision for both humanistic and scientific studies; that premature specialisation should be avoided; and that technical preparation for a particular profession should be conceived in such a spirit that it misses none of the essentials of a liberal education (see *NATURE*, September 7, p. 23). The Mathematical Association submits that from a school course of mathematics the pupil should acquire (1) an elementary knowledge of the properties of number and space; (2) a certain command of the methods by which such knowledge is reached and established, together with facility in applying mathematical knowledge to the problems of the laboratory and the workshop; (3) valuable habits of precise thought and expression; (4) some understanding of the part played by mathematics in industry and the practical arts, as an instrument of discovery in the sciences and as a means of social organisation and progress; and (5) some appreciation of organised abstract thought as one of the highest and most fruitful forms of intellectual activity. This statement is signed by Prof. A. N. Whitehead, president of the Mathematical Association, and by Mr. A. W. Siddons, chairman of the Teaching Committee. It will be remembered that the Association of Public School Science Masters has also expressed agreement with the resolutions adopted by the associations representing humanistic studies, and has emphasised the needs which natural science meets in the direction of the search for truth and of a comprehension of the part played by science in modern civilisation (see *NATURE*, October 26, p. 162).

To *Science Progress* for October Sir Ronald Ross contributes an essay dealing with the question whether our public-school education is in need of reform, and, if so, how much, from the point of view of parents. The discussions which have taken place in the House of Lords and elsewhere would seem to lead one to believe that there is general agreement as to some reform being necessary, but not as to its amount. Unfortunately there is a tendency for the modern educationist to believe that he alone should decide the nature of the curriculum, and many people besides the parents of public-school boys think that boys are taught what the schoolmaster is able to teach rather than what they should be taught. Lord Desborough's Committee for Public-School Reform sent to the parents of boys at Eton and other public schools a memorandum (published in *NATURE* of June 8) urging reform, and requesting replies for or against it. The response indicated that the parents are overwhelmingly in