

resultants of the varied treatments. In the process of dismemberment it must often happen that the true individuality of a soil is lost, so that schemes of laboratory classification sometimes arbitrarily separate agricultural similars and unite agricultural discordants. This was recognised in several of the discussions, and the students of the soil are now fully alive to the complexity of the problems needing investigation. In the opportunity afforded for comparing and criticising the diverse methods of research the congress was eminently successful; and on the social side it was wholly pleasurable.

#### EDUCATION AT THE BRITISH ASSOCIATION.

THE presidential address this year was devoted to the topic of university education. Readers of NATURE have already had an opportunity of reading Principal Miers's suggestive discussion of the relations of teachers and pupils at school, and of the change of method which should differentiate university from school education. Incidentally, the address raised the very practical question of the present overlapping of the two, and led to the appointment of a research committee, with the president as chairman, to investigate the subject and to report at Portsmouth next year.

The presentation of the reports of the Section L research committee on mental and physical factors involved in education, and of the committee of Section H on the establishment of a system of measuring mental characters, was made the occasion for a joint session of the two sections for the discussion of research in education. In the report of the committee of Section L the gradual integration of a science of education, drawing its data, as Prof. Schuyten wrote, from hygiene, anthropology, physiology, normal and abnormal psychology, pedagogy, and sociology, and yet with a common centre of reference and an inner coherence which set it apart from each of these related sciences, was indicated. The work in psychopedagogy now carried on in this country was briefly reviewed, and it was shown that, in spite of the lack of funds which was everywhere reported, researches were on foot in at least ten university centres. Prof. Green in his introductory remarks showed how poorly off we are in this respect in comparison with such countries as Belgium, France, Germany, the United States, and even with Russia, where the War Office, in discharging its responsibility for the education of the children of officers, maintains a professor and a laboratory for research work alone. He also urged the importance of training for researchers in this as in all other branches of specialised research, a point which was subsequently taken up by Dr. C. S. Myers and other speakers. Prof. Findlay explained how the university departments were in this matter sent from pillar to post, Treasury grants being refused on the ground that the Board of Education always looked well after their own, while the Board, on the other hand, in set terms disavowed all responsibility for research work. The position, as the president said, is "disgraceful."

A typical illustration of more purely pedagogical research was contributed by Dr. T. P. Nunn in his sketch of the methods of algebra teaching worked out in the demonstration schools attached to the London Day Training College. The old theory of algebra, associated with the name of Euler, in which the symbols are regarded merely as numbers—"a large number of numbers"—has given place to the view of Chrystal and others, to whom algebra is a systematic science capable of development from its own axioms. The difficulty of adopting this view for school purposes is precisely the difficulty which faces the new school of geography teachers, namely, that the rationalising motive, the desire to build up a system for its own sake, does not develop in the English schoolboy much before his sixteenth or seventeenth year. Dr. Nunn has therefore based his method on the utilitarian motive, and aims at every stage to exhibit the value of the results for application. At the same time he seeks to comply with the schoolmaster's demand that the subject shall have "training value." Thus algebra for school purposes becomes an instrument of the capabilities of which are throughout explored, and so extended, a kind of linguistic for the expression of thought operations. A large audience

followed with keen interest Dr. Nunn's application of the theory in such crucial instances as the factorisation of  $a^2 - b^2$ , and the explanation of the product of two negatives. The processes under his hand revealed the behaviour of realities, and no longer, as of old, came out of the void.

As an illustration of research upon mental processes Dr. Spearman gave an account of an inquiry into individual variations of memory among some 400 subjects. His results showed that the correlation coefficient between different ways of memorising was always positive, or, in other words, that the powers of memory showed some tendency to correspond, however the material upon which they were exercised might vary, while the more like two performances were the greater was the degree of correspondence. The common view that people of quick memory forget more rapidly than those to whom memorising is a slow process was shown to be erroneous, the correlation coefficient between the two remaining the same after a lapse of time. It was also shown that the difference between the two types could be largely traced to the method of recall, the quick memory being predominantly auditory and motor, the retentive memory visual and ideal. Finally, a high correlation was established between memory and teachers' estimates of general intelligence, in spite of the fact that the data upon which the latter were based were often obscure and variable.

The remainder of the sitting was occupied by a series of papers and discussions on the measurement of intelligence, in which accounts were given of practically all the researches on this subject hitherto conducted in this country. Dr. Otto Lipmann discussed the methods of Binet and Simon (*Année Psychologique*, 1908, xiv., pp. 1-94) and of Bobertag (*Zeitschrift für angewandte Psychologie*, iv.). His paper has been printed in full in *The School World* (October), so that here it will suffice to say that in his opinion their methods do not promise any certain test of a high degree of intelligence. We associate intelligence of this character with depth and power of self-criticism; but these things must be neglected in experimental tests, for results which would demonstrate the absence of these may be due to bodily condition or temporary inattention. On the other hand, the tests of Binet and Simon will establish with certainty whether a child is of sufficiently normal intelligence to be equal to the public-school course. The importance of this achievement will be seen when it is remembered that under English law a school medical officer may at any moment find it necessary to satisfy a bench of magistrates that a particular child ought to be sent to a special school for mentally defective children.

Mr. Cyril Burt described a series of experiments performed with a group of elementary-school children at Oxford, the result of which was to cast doubt upon the view that there is an intimate correspondence between power of sensory discrimination and general intelligence. A series of experiments with girls of secondary-school age at Liverpool tended to show that, by comparison with simple sensory and motor tests, tasks involving higher and more complex processes are less liable to be vitiated by absence of special training in the experimenter, and also have a more intimate relation with intelligence. Mr. William Brown discussed the mathematical technique of the evaluation of the results of intelligence tests, and maintained that the method of multiple correlation should always be employed.

Mr. J. G. Gray asserted the value of perseverance as an index of the quality of intelligence, explaining perseverance as dependent upon an elemental brain property which determines the persistence of mental impressions. He described a modification of Wiersma's colour disc devised by himself in order that the luminosity of the two colours the fusion of which at a certain rotation speed gives the index of perseverance might be regulated by the experimenter.

Mr. H. S. Lawson described a series of tests, based upon Binet's, to which the candidates for scholarships at a Midland secondary school were submitted. The order thus established was correlated with the official scholarship order in two successive years, the coefficients being 0.217 and 0.485. The tests had also been used to check the official order of merit obtained from a term's marks

in certain forms. In every case the correlation coefficient was high.

Miss Katharine L. Johnson read an interesting paper on the results of the application of Binet's tests to 200 school-girls in Sheffield. In her experience one of the chief difficulties was the personal equation of the experimenter. It is impossible to maintain the same tone and expression throughout, and children are very susceptible to suggestion. It is also difficult, sometimes, to estimate the results. She had found cases in which girls failed in the tests for their own age or for the age preceding, and yet satisfied the tests for a superior age.

Dr. E. Neumann's paper was summarised by Dr. Lucy Hoesch Ernst. He cast a doubt upon the possibility of determining a normal standard of intelligence for each year of school life which would be of general validity because of the difficulty of excluding acquired knowledge.

Dr. C. S. Myers entered a caveat against the collection of masses of psychological data by untrained observers. He was of opinion that the personal equation of the observer could not be got rid of, and that therefore comparison of results was only possible within very narrow limits. Racial differences in correlation are bound to vitiate the results of the examination of a sample of a heterogeneous people. But the main source of error lies in the neglect of the introspective element. A test of mental fatigue may in different subjects involve the play of such complicating factors as boredom, duty, ambition. It is only by individual introspection that we can determine exactly what factors an experiment involves. The result derived from the wholesale collections made by untrained observers can be nothing but a blur in the psychological aspect, though a sort of standard of productiveness may be obtained from them whereby we can measure the individual.

Dr. W. H. R. Rivers summed up the long discussion. In his opinion the work done was well worth doing, and marked a great advance regarded from the point of view of the scientific psychologist. But an enormous amount would still have to be done before the results could be applied practically in education. The work, so far, had been work with mass results, whereas the teacher wanted to test the individual. In spite of what had been said of the need for training in the investigators, it was all to the good that teachers were beginning to take up psychopedagogy.

On the third day of the meeting there was a series of papers on practical work in schools. The Board of Education's recent Memorandum on Manual Instruction came in for a good deal of praise. Sir Philip Magnus, as an old fighter in the cause of handicraft, urged that we should not fold our hands until the Board's four principles were everywhere observed, that handwork should be taught to all intending teachers, and that there should be a continuous course of it in every school taken by the ordinary teachers of the school. The president of the association spoke of the value of handwork as fostering self-help and initiative. Mr. J. G. Legge suggested the establishment of a type of school for boys from twelve to fourteen in which half the curriculum should be given to constructive work, and half the day should be spent in the workshop. Such a school would lead directly to technical training as the next stage in the education of the pupils. Mr. James Tipping described the vacation courses of the Educational Handwork Association, in which many teachers have acquired the manipulative skill, and at the same time the pedagogical knowledge, needed by teachers of handicraft; and Dr. G. H. Woollatt outlined a hundred-hour course for teachers in the making of scientific apparatus. Miss Clegghorn, in closing the discussion, warned the audience that enthusiasm in the teacher was a *sine qua non*, and hinted, at the same time, that it was difficult to be enthusiastic over the introduction of more subjects into the too short school life of the ordinary child.

Mr. Blair's paper on the relations of science with commerce and industry has already appeared in NATURE (September 15). The subject is usually treated on both sides in a spirit of vague vituperation which profits nothing. Mr. Blair's skilful marshalling of a mass of evidence from university graduates, professors, business men, and manufacturers all the world over will be of service to combatants on both sides who desire composi-

tion and not strife. In the short discussion which followed Principal E. H. Griffiths advocated bringing home to the lay mind the value of such work as Faraday's and Lister's. We should then hear less of the disinclination to believe in the application of science to business life and industry. He also advised scientific men to leave the language of the laboratory behind them when they came into the market-place, recalling Sir George Reid's words in the tests of intelligence discussion:—"It will be a grand thing when our men of science really do know everything they talk about, because when they do they will be able to tell us what it all means in plain English."

Dr. Beilby thought that things were improving; the great need was more cooperation between the two parties. The difficulty was to get the scientific man and the men of the markets together. In joint committees of professors and business men each side educated the other.

Sir William White also thought that there was no reason for alarm. We did not compare so badly with other countries. True, our rivals were better organised, but then organisation may paralyse effort. The young trained graduate of the technical college would not straightway apply his knowledge in industry; he had not the knowledge of practical business conditions. Such men should go through post-graduate courses, if possible, in works' laboratories. We must be content to train many mediocrities in order to catch the man of brilliant ability, and fortunately it takes all sorts to make the worlds of commerce and of industry.

Dr. Stead said that in the steel industry the value of research was recognised. The manufacturers had reached the point of wanting a little too much from research, and in too short a time.

Dr. H. E. Armstrong also advocated a two or three years' course in a work's laboratory for the technical-school graduate, and quoted the example of Sir Lothian Bell. Our organisation was at fault; when that defect was remedied the nation would soon regain its former commanding position in manufacture and commerce.

On the last day of the meeting an interesting series of papers was read on outdoor studies in schools of normal type. Prof. Mark R. Wright described the summer camp of the Durham Training College, Mr. G. G. Lewis showed what could be done by means of school journeys for London elementary-school children, and Mr. J. E. Feasey explained how much the interest and practicability of ordinary school work could be heightened by adapting it to the conditions of the open air.

In the afternoon there was a lively, though inconclusive, debate on voice production, in which Dr. Gray, Prof. Wesley Mills, Dr. Hulbert, Mr. W. H. Griffiths, Miss Ormay, Dr. Chichele Nourse, Prof. Silvanus Thompson, and others took part.

### THE PRODUCTION AND USE OF ELECTRIC POWER.<sup>1</sup>

THERE are few subjects more important to the people of this country than the question of the rapid and ever-growing rate at which we are using up our coal supplies. Many writers have dealt with this subject, and have suggested various remedies.

It may be said that the rate at which we can use coal is a measure of our industrial activity and prosperity. This would be true, perhaps, if we were using our coal without waste, or at least with reasonable economy, but it is certainly not true of what we are at present doing.

Taking all the uses for coal into consideration, I believe that we are getting back an amount represented by useful work of one kind or another of much less than 10 per cent. of the energy in the coal. We can never, of course, hope to get anything like the full value of the energy in the coal, but, on the other hand, throwing away more than 90 per cent. of the value of our coal in the process of conversion is of the greatest possible concern to the country. Moreover, there is a further waste involved in our present methods of using coal which is only second in importance to the one I have spoken of. We now dissipate nearly the whole of the valuable by-products con-

<sup>1</sup> From the Inaugural Address delivered at the Institution of Electrical Engineers on November 10 by Mr. S. Z. de Ferrant.