

with this it was gratifying to note the large number of new members, particularly so of those working in connection with the Board of Agriculture and Fisheries, and in the newly established university departments.

It is hoped that with the increase in the number of meetings there will be a still further increase in the membership, and that the association will take its position amongst the numerous other learned societies, thoroughly representative of all branches of applied biology.

To a very much larger extent than hitherto, the association will in the future play no unimportant part in defining the scope of economic studies in biology, and having now definitely taken up its headquarters in London, it will be more in touch with Governmental departments. Representative as its membership is of the universities of the country, and not a few of our Colonial departments, the possibilities that lie before it are endless, and should exercise a very profound influence upon the future of economic biology in this country, tending to raise its status to the level it occupies in other countries, and to become still more beneficial to the people of this country and its great Colonial Empire.

W. E. C.

#### FATIGUE AND EDUCATIONAL WORK.

THE London County Council's annual Conference of Teachers, held last week, yielded some notable pronouncements. On the opening day, January 1, Canon Masterman laid stress upon the training in morals and in imagination which pupils gain when history is properly taught. History provides an education in sympathy not only with our forefathers, but with "the brotherhood that binds the brave of all the earth." The true historian always cares supremely for the truth; the critical faculty of the pupil must be carefully trained. To the great deed they must offer their admiration, their gratitude if they could, and, if not, then their silence. The historian differs from the antiquary in his constant thought of the present; the boy who rides in imagination with the knight to the *Parliamentum* at Westminster will have a clearer idea of the responsibility of citizenship. The pageantry of history is sacramental; it has an inward and spiritual import, and, unless the teacher feel something of the spiritual significance of history, he had better teach algebra or mechanics all his life.

On the second day, Mr. W. H. Winch gave the results which had attended a few experiments he had made in testing the fatigue of adolescents who were in attendance at evening continuation schools. He pointed out that his experiments in connection with the fatigue of day-school pupils had yielded no satisfactory result, while he had found distinct evidence of fatigue in adolescents who continued their education in the evenings. His experiments indicate that, in the cases he examined, adolescent students suffered a loss of ability as the period of instruction drew to a close. He instanced six sets of experiments, and in the only case which did not show the results of fatigue subsequent inquiry showed that 75 per cent. of the students were not occupied during the daytime. From such evidence he concluded that evening continuation schools were not places of serious continued education for adolescents; they were a waste of educational appliances. The chairman, Dr. W. McDougall, Wilde reader in mental philosophy, thought these conclusions somewhat premature, as it did not follow that work which caused a measurable amount of fatigue was work which should, therefore, not have been undertaken.

Mr. T. H. Pear described an experiment in connection with the fatigue which ensues from loss of sleep in which it was demonstrated that the fatigue persisted long after the subject was of opinion that the effects of the lack of sleep had disappeared. He suggested that, on account of fatigue, the teacher who energetically changed from a strenuous lesson on one subject to a lesson of equal strain on another subject lost efficiency; the early lesson caused fatigue, and should have been followed by a period for recuperation.

The conference closed with a description of six educational experiments; it was announced, as evidence of the wide latitude for experiment allowed in the elementary schools, that no fewer than sixty descriptions of such experiments had been offered for the consideration of the conference.

#### ENGINEERING AT THE BRITISH ASSOCIATION.

THE Engineering Section of the British Association met under the presidency of Prof. Gisbert Kapp, who took for the subject of his address the electrification of railways. The address, which was printed in full in *NATURE* of October 9 (p. 184), was followed by an interim report of the committee on gaseous explosions, which very briefly chronicled the work accomplished during the year, and described the steps which are being taken to carry on further research work at the Imperial College of Science. One of the notes presented to this committee was also read by the authors, Profs. Petavel and Asakawa, and described some experiments on the effect upon gas-engine efficiency of varying compression ratio. In these experiments the brake-horse-power increased in the same proportion as the theoretical air efficiency, but the mechanical efficiency decreased as the compression ratio increased.

The concluding paper of the first meeting was read by Prof. Burstall on solid, liquid, and gaseous fuel, in which he discussed the various advantages obtained from each kind of fuel, and outlined a scheme for utilising, to the best advantage, a large daily supply of coal at the pit mouth by the production of coke, fuel gas, sulphate of ammonia, and various by-products of the tar obtained from the retorts.

The first paper on the Friday morning dealt with the application of the internal-combustion engine to railway locomotion, and described a bogie-coach of 60 ft. in length propelled by two six-cylinder Daimler engines through the medium of gears affording six-speed ratios. Recent trials demonstrate the feasibility of maintaining a high speed over long distances at a reasonable cost, and the author, Mr. F. W. Lanchester, advocated the running of such vehicles on main lines at frequent intervals as much more economical and satisfactory than a service of long trains at considerable intervals. In the paper which followed, Dr. Hele-Shaw described a new type of hydraulic weighing-machine of the piston type, in which packings are dispensed with, while friction and leakage are practically eliminated by ingenious mechanical devices.

The propulsion of barges on canals by aerial propellers was described by Mr. L. B. Desbleds, and although the possible efficiency of this system of propulsion was shown to be very small, the author considered there was a limited field for its application in cases where submerged propellers could not be employed.

Mr. Lanchester directed attention to the various factors which cause instability in aeroplanes, and with the aid of models demonstrated the important features

which are necessary to consider in the design of a stable aeroplane, especially as regards the tail-plane.

The cost of electric cooking was discussed by Prof. Morris, with reference to the result of one year's working in a flat within the London area. A paper by Mr. A. E. Bawtree on bank-note engraving was illustrated by a number of photographs describing various methods in general use for the prevention of forgery. The author showed examples of a new system of a geometrical character, which cannot be imitated by repetition work, or by mechanical devices such as the pantograph. The system which was not described was stated to allow the incorporation of a design which could only be made visible by a special screen. The concluding paper at this meeting was read by Mr. C. H. Lander on the frictional loss in steam pipes, and described experiments which agree with a dimensional formula due to Osborne Reynolds.

A joint meeting of Sections A and G took place on the Monday morning to discuss the report of the committee, appointed last year, to consider certain of the more complex stress distributions in engineering materials. The principal results of modern investigations on combined stress were discussed by Mr. W. A. Scoble, while alternating stress was similarly dealt with by Messrs. Mason, Rogers, and Eden, and a special report on the resistance of tubes to collapse was contributed by Mr. G. Cook. The discussion upon the report was opened by Prof. Perry, the chairman of the committee, who urged the importance of coming to a definite agreement as to the criterion of failure in a material subjected to stress. The discussion on the various sections was continued by Mr. Stoney and other engineers, and covered a wide range of subjects connected with the experimental investigation of stress distribution in engineering materials.

A Section A paper by Prof. Coker was, for the convenience of the meeting, read immediately after the termination of the joint discussion; it described the construction of polariscopes for examining the stress distribution in large models of engineering structures built up of transparent materials. A second paper by the same author described the preliminary results of an investigation upon the stress distribution in rings subjected to internal or external pressure, with apparatus which leaves every part of the ring free for measurement except the surface exposed to fluid pressure.

A paper contributed by Mr. T. Reid, described some experiments on the flow of solids based on the well-known experiments of Tresca. Lead cylinders divided in halves by a diametral plane are grooved to receive tin wires, which latter serve to map out the flow produced when pressure is applied to the cylinders. The experimental results appear to show that a very slow flow is stable, and that above a certain limit there is a condition resembling turbulence in a fluid.

A paper by Mr. A. Robertson described experiments on the strength of free-ended struts, in which Euler's formula is shown to hold good down to the length for which the stress given by this law is equal to the stress at yield, and, below this limit collapse occurs, when the load per square inch is equal to the yield stress. A concluding paper by Mr. A. T. Walmisley described the properties of non-ferrous metals which are of importance in structural engineering.

On the Tuesday morning the first paper on an engineering theory of the gyroscope was read by Mr. J. W. Gordon, who pointed out that when a gyroscope is precessing freely it is absorbing power, while in forced precession it is transmitting. By the application of suitable constraining devices many important practical instruments can be constructed, of small size, for the steering of ships, the prevention of rolling and pitching of aeroplanes, and the like. A short note by

Prof. Wilson on tests of metals and alloys, directed especial attention to the increased brittleness and rise of electrical resistance of duralumin on prolonged exposure to the atmosphere.

Papers dealing with various matters connected with wireless telegraphy were also read by Prof. Howe, who described the nature of the electromagnetic waves employed in radio-telegraphy, and the mode of their propagation. Dr. Eccles discussed atmospheric refraction and absorption as affecting transmission, and Prof. Marchant, the effect of atmospheric conditions on the strength of signals received at Liverpool from Paris and other wireless stations of great power. The final paper on Tuesday morning was read by Mr. W. R. Cooper, and described some practical suggestions for shortening the tests of temperature rise in electrical machines under working loads.

As in previous years, a meeting on the Wednesday was necessary for the consideration of several important papers, and a programme on civil engineering subjects was followed with much interest by a large audience. Dr. Vaughan Cornish described the landslides in the Culebra Cutting of the Panama Canal, especially those in which subsidence of the banks has caused numerous upheavals of the canal bottom.

A paper on the reconstruction of the station at Snow Hill, Birmingham, was read by Messrs. Gleadow and Shackle, in which the structural steel work was very fully described. The effect of harbour projections was discussed by Mr E. R. Matthews, and he advocated the use of piers inclined at such an angle to the shore that moving sand and shingle tends to sweep past the end of the pier and settle on the lee side. The transport and settlement of sand in water was also described, with many experimental illustrations, by Dr. J. S. Owens. An apparatus was also exhibited for exploring sand bars and river beds. It consisted of two concentric tubes closed above and open below, and provided with stop-cocks so that water under pressure can be forced through the inner tube to sink the apparatus in the sand or other material. When the desired level is reached a stop-cock communicating with the annular space is opened to allow a return passage for the water under pressure, and this carries with it a sample of the material at the base of the apparatus, and delivers it at the outlet.

These interesting experiments concluded a very successful programme of the Engineering Section at the Birmingham Meeting.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BRISTOL.—The degree of D.Sc. in engineering will be conferred on Mr. Charles F. Smith, who has submitted to the University records of his research work and publications in connection with electrical engineering.

LONDON.—The degree of doctor of science in chemistry has been conferred upon Mr. F. G. Pope, an external student, of East London College. In addition to a thesis entitled, "The Fluorine Group," Mr. Pope submitted a list of printed contributions to the advancement of science, published independently or conjointly.

The degree of doctor of science in geology has been conferred upon Mr. E. H. Pascoe, external student, of University College. Mr. Pascoe presented a published thesis entitled, "The Oil Fields of Burma," together with some further contributions to the advancement of science, published independently.

The following lectures to advanced students of the University, and to others interested in the subjects