

its flux, and thus compensating for the saturation. This device should prove especially useful in the case of rotary converters, where the commutation is often difficult; it will enable an increased output to be obtained from a machine of a given size.

A mathematical paper on "Electric Oscillations in Coupled Circuits" was read by Dr. Eccles and Mr. A. J. Makower. The special case considered was that in which three paths, each containing an inductance and a condenser, are connected in parallel. The formulæ obtained were confirmed by tests in two simple special cases, viz., two tuned circuits coupled either by a common condenser or a common inductance. In the discussion Prof. Howe showed that the two special cases dealt with experimentally could be calculated in a very simple manner by a suitable choice of initial conditions.

Prof. G. W. O. Howe then read a paper on "The Capacity of Aerials of the Umbrella Type," in which the method described by the author at the Sydney meeting last year was extended to aerials of this type. In the discussion Prof. Schuster pointed out that the small error due to the author's assumption of a uniformly distributed charge would be always in the same direction.

A note on "Earth Resistance" was read by Prof. E. W. Marchant, who suggested the use of the equivalent length of a column of the earthy material, which, with a cross-section equal to the surface of the buried conductor, would have the same resistance as the actual earth, as a criterion of the "earth." Prof. Howe showed that this "equivalent length" depended merely on the dimensions, and need not be determined experimentally, since such measurements depended on the uncertain specific resistance of the soil; it could be calculated in the same way as the capacity, if the conductors were surrounded by an insulating medium. Dr. Eccles pointed out the need for caution in applying the continuous or low frequency resistance to the case of a radio-telegraphic aerial.

Messrs. Lacey and Stubbings described some experiments to determine the effect of a third harmonic on the iron losses of a three-phase transformer, the harmonic being due to the saturation of the cores. With a triple harmonic of 48 per cent. the iron loss decreased 22.5 per cent. on opening the neutral wire; this would prevent any third harmonic in the current and would remove the sine-wave constraint from the magnetic flux, which would consequently reach a lower maximum value.

Prof. E. Wilson gave further information about a number of aluminium alloys, which have been exposed on the roof in London for many years, and on which he has reported on previous occasions.

Saturday, September 11.—Mr. T. H. Brigg described a new method of attaching horses to vehicles, the principle of which is that the shafts are forced upward by a spring, thus relieving the horse of a part of his own weight when travelling on an easy road. As soon as the road becomes more difficult, owing, say, to an up gradient the increased pull on the traces overcomes the spring and exerts a downward force on the shafts, enabling the horse to obtain the necessary adhesion on the road.

The report of the committee on complex stress distribution was read by Prof. Coker. It consisted mainly of a comparison of the behaviour of a sample of mild steel when subjected to steady and alternating stresses respectively.

A paper on the strength of iron and steel struts was read by Mr. A. Robertson. It was a record of experiments on solid, free-ended, centrally-loaded struts made at Manchester University. The results

confirmed Euler's formula, except for very short struts; the latter are discussed in detail in the paper.

Prof. C. Batho described a new method of determining the torsion stresses in framed structures and thin-walled prisms, especially useful in the case of cantilever bridges in which the suspended span is subjected to torsion, owing to unsymmetrical loading on the cantilever and anchor arms. The author showed the application of the method to a bridge of similar design to the new Quebec bridge.

Prof. Miles Walker described some experiments made to determine whether the acceleration of one mass exerts any force on a neighbouring mass, as it should do if the analogy between the electric current and the movement of matter be perfect. The results obtained were negative, although the apparatus combined great sensitiveness with the very rapid acceleration of large masses. Prof. Schuster expressed regret that a paper of such physical importance had not also been brought before Section A (Physics) of the Association.

This brought the proceedings of Section G to a close.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

IN Section H (Anthropology) the proceedings showed little departure from the normal except perhaps in the small number of ethnographical papers, and in the character of the discussions which, on the whole, were a little less vigorous than usual, owing to the absence of many who, as a rule, may be counted upon to take part in the debates. The programme, however, showed a longer list of communications than might have been expected.

As in other sections, subjects of special interest at the moment were not neglected. Indeed, the principal item in the programme was a discussion which took place in joint session with Section E (Geography) on "Racial Distribution in the Balkans." This was opened by Prof. G. Elliot Smith, who, after a lucid exposition of the geographical, ethnological, and historical factors which have brought about the segregations and disunion of the Balkan peoples, went on to show that in spite of conflicting interests arising out of differences of history and creed, ethnological no less than geographical and economic considerations definitely linked together the Slovenes, Croats, and Serbs as one race, whose domain included not only Croatia (with Slavonia), Bosnia, Herzegovina, Montenegro, and most of Serbia as at present delimited, but also Dalmatia, nine-tenths of Istria (excepting Trieste), Carniola, and a strip of South Hungary. On ethnological grounds Bulgaria had a greater right than Serbia to the part of Macedonia now in occupation by the latter, and on racial grounds her claim to the Dobrudja was more justifiable than that of Rumania. Sir Arthur Evans exhibited a diagrammatic map illustrating the ethnic relations between the Adriatic, the Drave, and the Danube, the result of many years' observations in the area which is now occupied by the southern Slavs or Jugo-Slavs. Ethnological considerations supported the argument for a Jugo-Slav State. Italic preponderance was situated in the lower valley of the Isonzo, at Trieste, and in Istria. In Dalmatia, except in the town of Zara, the Italian element amounted to about 3 per cent. only of the population, the prevalence of Italian culture and the use of the language for commercial purposes giving a wrong impression. Sir Arthur then pointed out the value of the establishment of such a state in facilitating the completion of a railway, joining up

east and west along the main Roman road from Aquileia to Nissus, and running from Milan to Nish through Gradisca, Laibach, and Belgrade. The Hon. W. Pember Reeves, who was unable to attend the discussion, sent a communication in which, in dealing with the position of the Greeks, he urged that on historical and ethnological grounds their present northern boundary, including Epirus, corresponded closely to the ideal; while in Macedonia the line dividing the Bulgar-Slav portion from the Greek drawn by the Treaty of Bukarest represented the facts, especially as since the war of 1912-13 much migration had taken place on each side of the line. The claims of Greece to Bulgarian Thrace were justifiable on economic rather than ethnic grounds; on the other hand, the claim of Bulgaria to the eastern part of Macedonia was stronger than that of Serbia. In Monastir the existence of Vlach, Bulgarian, and Greek elements gave rise to a separate problem. It is scarcely necessary to emphasise the fact, upon which stress was laid by each speaker in turn, that political considerations had no part in the discussion.

Another matter of topical interest was the subject of a communication by Prof. Arthur Keith. In 1905 Prof. E. Manouvrier, of Paris, published a paper entitled "Une Application Anthropologique a l'Art Militaire: le Classement des Hommes et la Marche dans l'Infanterie," in which he advocated the classification of soldiers according to length of the lower limbs, rather than according to height, in order to minimise fatigue. This publication had not received attention in this country at the time of its publication, and a summary of its contents was now presented to the section at the request of the author. In the discussion which followed the hope was expressed that the suggestions might be put to a practical test.

A second discussion had for its subject "The Influence of Egyptian Civilisation on the World's Culture." It was opened by Prof. Elliot Smith and Mr. Perry. Their communications covered a wide field. They argued that towards the close of the new Empire a great many of the most distinctive practices of Egyptian civilisation, carried possibly in part by Phœnicians, suddenly appeared in the more distant parts of the coast lines of Africa, Europe, and Asia, and in course of time in Oceania and America. Mr. Perry relied in particular on the association of megalithic buildings and mine workings, or the situation of such monuments in or near regions noted for gold, precious stones, or pearl fisheries, as well as on similarities of technique in smelting or refining operations. In the discussion which followed, the opening speakers were subjected to some severe criticism. Sir Arthur Evans, while feeling that it was impossible to discuss adequately a subject of such vast extent, attacked their method of dealing with the evidence, and Prof. Petrie emphasised the necessity for greater precision in dating the facts with which they dealt. Sir Richard Temple pointed out certain difficulties in this connection in the treatment of the Indian evidence. Dr. Rivers, in supporting the openers, explained the reasons which had led him to modify his previous opposition to their position. The president pointed out that the difficulty of the length of time necessary for such a diffusion of culture was perhaps not so great as might be thought; a complete change had taken place in the diet of the native of South Africa since the discovery of America, when maize was introduced to the Old World.

Other communications, in addition to this discussion, also dealt with Egyptian archaeology. Mr. Robert Mond made a valuable contribution to the method of recording archaeological discoveries with an exhibit of a cardboard folding model of the Theban

temple of Menna at Gurnah, on which photographs recorded all the scenes painted on the walls of the two chambers exactly in the position in which they were found. He proposes to survey all the temples and buildings of ancient Egypt in the same manner. Prof. Petrie described the magnificent find of twelfth-century jewelry of a princess, daughter of Senusert III., found by the British School of Archæology in Egypt at Lahun, which is in some respects finer than any yet known.

What was, however, felt to be one of the most important communications made to the section in the course of the meeting was a paper by Dr. E. A. Gardiner, "Fresh Light on the Origin of the Semitic Alphabet," which dealt with inscriptions of Pharaonic date in an unknown writing discovered by Prof. Petrie in Sinai in 1905. The inscriptions would appear to be alphabetic. A detailed analysis supported the conjecture that the system was related to, if it did not actually represent, the common parent of the Phœnician, Greek, and Sabæan alphabets. This Proto-Semitic alphabet apparently was hieroglyphic and acrophonic, i.e. the value of the letters was taken from the names of the things they represented.

Sir Arthur J. Evans, following Dr. Gardiner, dwelt upon the value for comparative purposes of the Cretan analogies for the origin of the alphabet, which were decisive against De Rougé's theory that the Semitic alphabet was derived from hieratic Egyptian forms representing similar sounds but having no reference to the actual meaning of the later name. To a certain extent the Minoan and Cretan forms appeared to belong to related systems. Dr. Gardiner's evidence tended to show that Semitic letters were derived from an indigenous source, and if the early forms went back to 1500 B.C. they could not have been introduced from Crete by Phœnicians. Nor did the *aleph-beth* theory of Gesenius require Egyptian influence, though it might have been present in both Semitic and Minoan as a formative element.

An interesting paper by Prof. R. S. Conway dealt with the religion and linguistics of early Italy. He described some votive offerings to the Venetic goddess Rehtia discovered on the site of a temple at Este, the ancient Atesta, about eighteen miles south of Padua. The offerings, which were of two classes, consisted of votive nails and wedges recalling Horace's description of *Diva Necessitas*, and bronze tablets divided into longitudinal bands, ten or twelve in number. The latter, the author suggested, might be connected with a game, and possibly were offerings of lucky players.

Two communications dealt with British archæology. The first, by Mr. J. P. Bushe-Fox, described the excavations at Uriconium in the year 1912-14. The finds included a large amount of pottery, evidence of industrial occupations, and a building of unique form. The second, by the Rev. Dr. Dukinfield Astley, on "Early Man in Norfolk," discussed the further evidence for the existence of Aurignacian man in East Anglia furnished by the results of excavations in Norfolk undertaken in 1914.

Among the papers dealing with social organisation and religion was an important communication by Dr. W. H. R. Rivers, on "Ceremonial and Descent in Ambrim," which adduced evidence to show that though at the present time the institutions of the island are patrilineal, in the older ceremonial, which is indigenous, the mother's brother comes into prominence. Consequently in this part of Melanesia it would appear that matrilineal institutions preceded the patrilineal.

Miss Margaret Murray, in her paper on "Royal Marriage and Matrilineal Descent," dealt with the

custom of sister marriage in the royal Egyptian and Semitic families, which, as she pointed out, were not regarded as unusual when recorded by native historians, and traced the customs to a more prolonged survival of inheritance in the female line in royal families. Dr. Nadine Ivanitzky's communication on "The System of Kinship among Primitive Races in connection with their Mode of Grouping" dealt with the manner in which economic and social factors act and react on the recognition of kinship in a group by determining the size of a group, its relation to other and competing groups, and the relation of the individuals within the group.

In physical anthropology, in addition to the paper by Prof. Keith, to which reference has already been made, Dr. Manson exhibited photographs and skiagraphs of members of a family showing hereditary syndactylism and polydactylism, and Dr. G. W. Hambleton discussed chest types in man in relation to disease. Prof. Guiffrida-Ruggeri's "Notes on the Neolithic Egyptians and Ethiopians," criticising the theories of Prof. Elliot Smith and others on the physical affinities of the early inhabitants of Egypt, and Prof. Elliot Smith's communication on "The Earliest Human Remains from India," owing to lack of time, were taken as read.

At the close of the proceedings, the section, at the invitation of the Ribchester Museum Committee, visited the Roman camp at Ribchester for the formal opening by Prof. F. J. Haverfield of the recently completed Museum of Roman Antiquities. Prof. Haverfield then delivered an address on the purpose of the small *castella* or forts, found scattered over all the north from Chester to Carlisle and from the vale of York to Tyneside, of which Ribchester is an example, as purely military units controlling the country from strategic points.

THE RELATION OF EDUCATION TO INDUSTRY.¹

AT the last meeting of the British Association in Manchester, in 1887, the president, Sir Henry Roscoe, in his opening address, referred to national education with patriotic candour, in the following prophetic sentence:—"The country is beginning to see that if she is to maintain her own commercial and industrial supremacy the education of the people from top to bottom must be carried out on new lines. The question as to how this can be most safely and securely accomplished is one of transcendent national importance, and the statesman who solves this educational problem will earn the gratitude of generations yet to come."

A generation has passed since Sir Henry Roscoe uttered his prophecy, and still our national education is, though improved, far from being carried out on the principles and methods which will ensure our industrial supremacy. In other words, "the statesman" has not yet appeared!

By national education we mean, of course, the education of the whole people, not of a class only. From 1872 until as late as 1889 no attempt was made by Government to provide secondary and technical education in continuation of the elementary stage, and in consequence of this the progress made in scientific knowledge bearing on industry and commerce was withheld from our own people who most needed it, and left to other nations who were better qualified to reap the advantage. The results, it is well known, have been lamentable, for it so happened that it was

during this very period that the most remarkable discoveries and development in science were revealed to the world, and their practical application demonstrated. During that period, and indeed long before, notably in Faraday's lifetime, England produced some of the most eminent men of science in the world, who opened out to us the immeasurable possibilities of adding to the material wealth and prosperity of our country by the adoption of their discoveries.

Only two countries, however, were ready to take practical advantage of these discoveries owing to their widespread facilities for education ranging through the elementary to secondary and technical schools up to scientific teaching in the universities. These countries were America and Germany.

Consequently the great discoveries relating to the utilisation of those subtle forces of electricity and magnetism achieved their first triumphs in these two countries, where the spirit of education had long before penetrated the lives of the people and prepared them to adopt and apply the new revelations of science to the common needs of human life.

These great movements stirred our Government at last to send out a Royal Commission to investigate the educational facilities in the secondary and technical schools of foreign countries. Oh, the pity of it! That a country which had enjoyed the greatest opportunities for the application of scientific discoveries and methods to industry through the undisturbed monopoly of engineering, chemical, and other industries extending over a full century, should have neglected the only means of retaining that position by the adoption, during the years of expanding wealth and prosperity, of a system of universal, free, and enlightened education open to every class throughout the land! The reports brought back from Europe by the Royal Commission, and one from America, written by myself after eight months' investigation, spread alarm throughout the United Kingdom and the British Empire. These reports were published in 1884. No action was taken by Parliament until 1889, when happily a Technical Instruction Act was passed, within two days of the close of the session, but almost by a fluke even then, owing to the efforts of a few desperate men on both sides of the House who believed that "through lack of knowledge the people perish."

Probably no Act of Parliament was ever seized upon with such avidity as this Technical Instruction Act, for, as the municipalities themselves were by the Act constituted the local administrative authorities, the large manufacturing districts, notably Manchester, Salford, and other parts of Lancashire, were especially eager in pressing for its adoption. The following year the "whisky and beer tax" was earmarked for the support of technical education, which resulted in numerous fine institutions being erected in many parts of the country. In 1902 secondary education was adopted permissively in a new Elementary Education Act, and though not adequate to meet the wants of the country, it was received with thanks for small mercies owing to the fact—which in some other countries would have been foreseen—that no system of thorough technical education can be carried out where secondary education is a missing link, so that for a time our rational system of public elementary and technical education minus the secondary was more like "a rope of sand than a chain of welded links."

As a result of the passing of the Technical Instruction Act of 1889, the development of technical instruction was so rapid that in 1895 an Association of Technical Institutes was formed. A large number of new schools have been erected solely for the purpose of technical instruction, and are equal in equipment and staff to the average of those in the United States and

¹ Abridged from a paper read before the Section of Educational Science of the British Association at Manchester on September 11, by the Right Hon. Sir William Mather.