

is equally useful for this purpose, that wool will take the place of cotton in the manufacture of nitrocellulose for propellants, or that a cargo of phosphate has been seized lest it should be used by the enemy for the manufacture of phosgene gas."

Dr. Garnett suggested that, perhaps, in course of time, the Committee of the Privy Council concerned with the development of scientific and industrial research may, as in other cases, be replaced by a new Ministry; and that a National Chemical Laboratory might be established corresponding to the National Physical Laboratory, though the diversity of chemical trades and interests suggests that several co-ordinated laboratories would be required.

Mr. Fleming's account of the enormous amount of industrial research being carried on in the United States by individual firms, and the increased provision being made for research in universities and technical institutions, shows that America is fully alive to the commercial advantages of such work. He stated that in the United States at the present time there are upwards of fifty corporations having research laboratories, costing annually from 20,000l. to 100,000l. each for maintenance; and he added:—"Some of the most striking features of the research work in America are the lavish manner in which the laboratories have been planned and which in many cases enable large-scale manufacturing operations to be carried out in order to determine the best possible methods of manufacturing any commodity developed or discovered in the laboratory; the appreciation of men of higher scientific training by industry, resulting in increasing numbers of students proceeding to their doctor's degree before leaving the university; the increasing attention given in the research laboratories to pure science investigations, this being, in my opinion, the most important phase of industrial research; the absorption of men who have proven their capacity for industrial research in such places as the Mellon Institute, the Bureau of Standards, etc., by the various industries in which they have taken scientific interest."

While much work of prime importance has been done by individual investigators in this country, there is a general lack of appreciation by manufacturers of the advantages to be derived from the application of science to industry, and a tendency to avoid the employment of scientifically trained men. Steps have been taken by the Royal Society to organise scientific workers, and the Chemical Society has formed committees representing all branches of chemical science. Similar organisations of technical experts have been brought together by engineering societies. What seems to be particularly needed is a combination of the forces of education, science, manufacture, and commerce, instead of bodies in which these interests are separately represented. The only body in which this combination exists is the British Science Guild, which was founded in 1905, with the express object of bringing home to all classes "the necessity of applying scientific treatment to affairs of all kinds." The present European crisis affords an opportunity of unique importance for the guild to impress upon all who are engaged in the executive functions of Government, and especially upon those who are engaged in the sphere of industry and commerce, the paramount claims of science in its most advanced aspects of training and research.

The events of the present war have shown with striking clearness, not only the advantage which systematic education in science and thorough organisation of scientific research in its various applications have given, whether from a chemical or engineering point of view, to the chief of the Central Powers with

which the Allies are engaged, but they have shown with no less emphasis the extent to which in the region of scientific industry Germany has grown to be the most formidable rival of the United Kingdom.

This result is not due to any merely adventitious circumstances, but is the direct fruit of the sedulous cultivation of science and of scientific research during the last sixty years, especially in the highest educational institutions of Germany; and it is the result also of the frank and liberal recognition by the great departments of the State and by the leaders of industry and commerce of its vital importance to the economic progress and well-being of the nation.

The recent important memorial, signed by men of high scientific and technical eminence engaged in the various departments of pure and applied science, directed the attention of the public to the grave character of the problems involved. It is now necessary to invoke the aid of the influential technical associations concerned with the development and advancement of the great scientific industries, of the chambers of commerce in the chief industrial and commercial centres, and of bodies representative of the workers engaged in the service of the more important industries. It is necessary also to engage the influence and support of bodies charged with the development of agriculture, in respect not only of improved scientific means and methods of cultivation, but also of the introduction into agriculture of other products of high value, with a view to render the nation less dependent upon foreign sources for its food supplies.

It is of prime importance that consideration should be given to the conditions upon which the *personnel* of the public service is recruited, particularly in respect of the choice of the higher officials. We may thus ensure a much closer sympathy with, and a keener appreciation of, the value of science and of its close relation to national progress, with the consequent careful and generous consideration of the curricula of the schools, so as to include a fuller measure of observation and experiment, and provide the means whereby the gifted of all classes can avail themselves of the highest facilities for education.

With the object of giving effect to these purposes and aims the British Science Guild is preparing a statement which will be submitted to leading representatives of many national interests, and the whole subject will afterwards be brought before the Government and the nation. The technical Press could perform a useful service by directing attention to the opportunity which the guild affords of uniting industry with education and science for their common good.

USE OF FOSSIL REMAINS OF THE HIGHER VERTEBRATES IN STRATIGRAPHICAL GEOLOGY.¹

THE study of fossil fishes, referred to in the presidential address to the society in 1915, raised the question as to whether animals of apparently the same family, genus, or species might not originate more than once from separate series of ancestors. The higher vertebrates, which inhabited the land, may most profitably be examined to throw light on the subject; for the land has always been subdivided into well-defined areas, isolated by seas, mountains, and deserts, so that animals in these several areas must often have developed independently for long periods. Students of shells are unanimous in recognising what they term homeomorphy, and trace immature, mature, and senile stages in the course of every race that can be followed through successive geological formations.

¹ Abstract from the presidential address delivered to the Geological Society of London on February 18, by Dr. A. Smith Woodward, F.R.S.

Vertebrate skeletons, which have much more numerous and tangible characters, and approach senility in more varied ways, should afford a clearer view of general principles.

Even among vertebrates the evidence that most concerns the geologist is not always easily interpreted. For instance, the Sparassodonta and horned tortoises of the Argentine Tertiary are so closely similar to the existing Thylacines and the fossil *Miolania* of Australia, that they are still sometimes quoted as proving the former existence of an Antarctic continent uniting the South American and Australian regions. On the other hand, they may be merely survivors of cosmopolitan races at the two extremes of their former range, with certain inevitable (but not altogether similar) marks of senility. In making comparisons, indeed, it is no longer enough to distinguish the fundamental and merely adaptive characters of animals; it is also essential to note separately those characters which depend on the early, mature, or senile position of the particular animals in the evolving series to which they belong.

Hitherto there seems to be only one case in which we have enough materials for forming a judgment as to whether a fundamental advance may occur more than once. Mammal-like reptiles are abundant in the Permian of North America and in the Permian and Trias of South Africa and other parts of the Old World. Recent studies have shown that all specialisations in the North American forms are in the direction of higher reptiles, while all those in the South African forms are in the direction of mammals. Hence, although there is evidence of two possible sources of mammals, only one appears to have produced them.

Among advances of lower degree, the origin of the monkeys or lower Anthropeida may be considered. It is agreed that they arose from the Lemuroidea which were almost universally distributed over the great continents at the beginning of the Tertiary era. They seem to have evolved separately in America and in the Old World, but the two series are very sharply distinguished, although they form one zoological "sub-order." When isolated on the island of Madagascar, some of these same animals acquired a few peculiarities of the American, others of the Old World Anthropeida, but never really advanced beyond the Lemuroid stage, merely becoming senile just before their extinction. Hence, the Lemuroidea evolved in three different ways, and the resulting groups are very easily distinguished.

The study of the Tertiary Ungulata is especially important, because most of the groups arose either in North America or in the Old World, which were united and separated several times. It seems clear that, although each group probably originated but once in one particular area, its members soon diverged into several independently evolving series, each imbued with some definite impulse or momentum towards specialisation in the same way in the course of geological time, only at different rates. There were thus, for example, several distinct lines of horses and rhinoceroses, but all from the same source.

It is now well known that the characteristic South American Tertiary Ungulates arose in an isolated area, and many of their specialisations are curiously similar to some of those observed among European Eocene and Oligocene Ungulata which soon proved abortive or "inadaptive." They are, however, by no means identical.

While so many changes have occurred during the evolution of the vertebrates, the persistence of characters and the strength of heredity in numerous cases are still as perplexing as they were when Huxley first directed special attention to "persistent types."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. A. V. Hill, Humphrey Owen Jones lecturer in physical chemistry, and Mr. J. E. Davey have been elected fellows of King's College.

Mr. F. P. White, St. John's, has been elected to an Isaac Newton studentship for three years, and Mr. H. Jeffreys, St. John's, has been re-elected to a studentship for an additional year. The Allen scholarship for research in scientific subjects has been awarded to Mr. Franklin Kidd, St. John's.

LONDON.—Prof. H. Jackson, of King's College, succeeds Prof. A. W. Crossley as one of the representatives of the faculty of science on the Senate.

The report of the Military Education Committee for 1915 has been presented to the Senate. It states that the number of members of the University of London O.T.C. during the training year ended September 30 was 2209, of whom 1068 proceeded to commissions during that year. Up to the end of 1915, 2228 cadets or ex-cadets of the contingent had been granted commissions. Of these eighty-six had fallen in the war, and the honours and distinctions gained were one V.C., twenty-five military crosses, sixty-three mentions in despatches (four mentioned twice), and one *Medaille Militaire*. In addition, 273 commissions had been granted to graduates and students (other than cadets or ex-cadets), and these officers had gained four military crosses and ten mentions in despatches. Since the outbreak of war, eight monthly courses had been held in the officers' school of instruction in connection with the contingent, and more than 900 officers had passed through the school. Lists of officers who have fallen in the war and have gained distinctions are printed as appendices to the report.

OXFORD.—The Herbert Spencer lecture was delivered on March 15 by Prof. J. Mark Baldwin. Taking for his subject "The Super-State and the 'Eternal Values,'" Prof. Baldwin spoke of the distinction, on one hand, between instrumental and eternal or absolute values, and, on the other, between individual and super-individual values. Pointing out that these distinctions are not peculiarly German, he went on to show that with the advent of the present war it became evident that in the German conception the State is not a vehicle of simply individual or instrumental value. It is, according to the Germans, the expression of the full national will; it is value *per se*, summing in itself the two super-individual values. The monarch symbolises this; no concession to the popular will is possible under such a conception, but the populace may be the recipient of free gifts from the State. Natural selection, or the survival of the fittest, is recognised, as, for example, in the victory of Turks over Arabs in the thirteenth century, or of Rome over Greece. Germany recognises two kinds of fitness—military efficiency and organisation. The spiritual and ethical weapon is wielded by the State alone. Military necessity knows no moral law; "might is right," *i.e.* super-individual might makes individual right. The observance of treaties is subordinate to the needs of the State; to be once a German is to be always of super-individual value; "Deutschland über Alles." So much for the German ideal. The opposed point of view makes itself felt in various domains, as in that of naturalisation, where the experience of the war has proved that documentary evidence is useless; in that of arbitration; and in that of cultural relations between peoples. In fine, Germany says that the nation is instrumental to the State; the democratic belligerents opposed to Germany hold that the State