furnace at Remscheid was still in good condition after four months' continuous working at high temperatures. Calculations based on the same tests showed in actual maintenance costs a saving of more than 50 per cent. in favour of zirconia as compared with the refractory lining ordinarily used. Ferro-zirconium, containing up to 35 per cent. zirconium, obtained by reducing a mixture of the oxides with aluminium, has been prepared and used as the basis of introduction of the metal into steel for armour-plates, armour-piercing projectiles, and bullet-proof steel.

Zirconia also finds application as an addition to melted quartz to prepare "siloxide glass," a product resembling quartz opaque glass, but harder, less fragile, more resistant to mechanical stresses and basic oxides (excepting alkalies), and less easily devitrified than quartz glass.

Recently Ruff and Lauschke have investigated the refractoriness and other properties of zirconia, alone, and mixed with certain other oxides.

HYDRO-GEOLOGY IN THE UNITED STATES.[1]

DIPPING into a bundle of recently issued reports of the United States Geological Survey, all exhibiting evidence of the scrupulous care and unwearied industry of those responsible for the collection of data relating to the water-bearing capacities of the several regions under observation, we extract from a considerable mass of information one or two items which seem to possess some general, as well as local, interest.

(1) The topography of certain parts of Arkansas and the adjoining States is characterised by numerous low, circular mounds, from 20 to 100 ft. in diameter, and from 1 to 4 ft. in height. It is stated that in certain districts they are present in astonishing numbers, many fields being completely covered with them. They occur indiscriminately among the unconsolidated clays, loams, marls, sands, and gravels in the lowlands, on the uplands of Cretaceous and Tertiary age, and on the slopes of Palæozoic hills. The materials of which they are composed are in some cases slightly coarser and lighter in colour than the surrounding soils, while in other cases the components are essentially similar in structure, composition, and colour. No satisfactory explanation has yet been put forward to account for these conformations. Springs and gas-vents, coastal dunes and ant-hills, wind action and human agency, have all been suggested as originating or contributory causes; but no single theory fits in convincingly with all the conditions and facts. They remain a standing puzzle to observers.

(2) The broad desert valleys of New Mexico, composed of gravel, sand, and clay, are designated "bolsons." Rising up at intervals from the level uniformity of their surfaces are narrow, rocky ridges, ranging in length from two to twenty miles, and in height from a few hundred to nearly 2500 ft. It is probable that all these ranges have an underground connection, forming in reality a single range. They represent a thick succession of sedimentary rocks of all ages, from Cambrian to Recent, overlying pre-Cambrian granite, which outcrops in some of the ridges. In places the depth of the bolson deposits runs to considerably more than 1000 ft.

(3) The chief water-bearing formations of Connecticut are the unconsolidated materials of Glacial origin which overlie the bedrock. There are two types—the unstratified and the stratified, the former a heterogeneous mixture of débris deposited directly by ice, and the latter the same ingredients, but reassorted and deposited by water. The Glacial drift is only thin, and the surface of the underlying rock rugged. This results largely in the localisation of much of the rainfall (amounting to 45 in. per annum), causing supplies, at times, to be deficient through periods of several weeks, or even months.

(4) One of the difficulties confronting settlers in the San Joaquin Valley, California, is the adverse influence on plant culture of the alkali salts in the soil. If the alkali content be in any degree excessive, growth is retarded, and possibly arrested altogether. The farmer has to control the accumulation of soluble salts near the surface of his land, if he is to obtain satisfactory results. A common practice is to flood the area with water, which dissolves the alkali salts and carries them down below the zone of influence on delicate rootlets; but this method is only partially effective, unless measures are taken to prevent surface evaporation by means of the shade afforded by trees and the cover of stands of grass or grain. B. C.

[1] (1) "Geology and Ground Waters of North-Eastern Arkansas." By L. W. Stephenson, A. F. Crider, and R. B. Dole.
(2) "Geology and Underground Water of Luna County, New Mexico." By N. H. Darton.
(3) "Ground Water in the Hartford, Stamford, Salisbury, Willimantic, and Saybrook Areas, Connecticut." By H. E. Gregory and A. J. Ellis.
(4) "Ground Water in San Joaquin Valley, California." By W. C. Mendenhall, R. B. Dole, and H. Stables.
(Published by United States Geological Survey, Washington Government Printing Office, 1916.)

SCIENCE AND INDUSTRY.

THE important and impressive review of the rise and progress of the organic chemical industry issued by Messrs. Levinstein, Ltd., of Blackley, near Manchester, and of Ellesmere Port, which appeared as a supplement to the *Manchester Guardian* of June 30, marks a welcome development of industrial enterprise. Even the most indifferent and ill-informed reader cannot but be made aware, as a result of its perusal, of the importance of the highest facilities for scientific education and training, when in so striking a fashion he is compelled to realise the fruits of it in the enormous industrial advance of Germany in all that pertains to the organic chemical industries, whether it takes the form of artificial dyestuffs, synthetic organic products, or that of chemico-therapeutics. The advent of the war quickly laid bare our serious deficiencies, not to say our utter poverty, in all three departments of chemical manufacture.

In the course of the articles, which have been written by men eminent in their respective fields of chemical science and its applications, the distinction is made absolutely clear as between industries the development of which has mainly been the result of the adoption of steam power and of mechanical appliances, and those depending upon fundamental researches of a physical and chemical character, such as are, to use the phrase of one of the writers, "built up from the depths," and require, therefore, not merely the energetic business organiser and "scientific management," with a view to output, but the highly trained scientific man capable of appreciating the discoveries of pure science and apt in their application to human needs. In this valuable review of the progress of the many departments of a vital industry—the key, indeed, to the successful prosecution of many allied and dependent industries—it is clearly revealed how remiss the nation has been in a true appreciation of what constitutes the firm foundation of industrial pre-eminence. The fault has lain not so much, as some of the writers seem to indicate, with the colleges and universities as with the industries concerned, which have hitherto offered small salaries and poor prospects to the carefully trained and competent science student; indeed, have looked upon

the chemist as a necessary evil, to be avoided if possible.

One of the most important articles is that by Dr. Levinstein, inasmuch as he carefully points out the respective spheres of the university and the works in the effective training of the future industrial chemist. Once those concerned with the successful administration of our industries realise the necessity for encouraging by a liberal payment the work of the efficiently trained chemist there will be no lack in the supply of suitable men. That the nation contains such men has been shown by the fact that the demands of this devastating war for the supply of high explosives have been met with an energy and an efficiency which have surprised our chief enemy.

THE AMERICAN ASSOCIATION.

STANFORD MEETING OF THE PACIFIC DIVISION.

THE second annual meeting of the Pacific Division of the American Association for the Advancement of Science was held at Leland Stanford Junior University on April 5–7. In all a series of twenty-two sessions was provided, at which more than 130 papers were presented. At a general session on the evening of April 5 an address was given by Dr. J. C. Branner, retiring president of the Pacific Division, upon "Some of the Scientific Problems and Duties at Our Doors," and on the evening of April 6 Dr. F. J. E. Woodbridge, professor of philosophy at Columbia University, presented an address upon "History and Evolution."

One of the principal features of this meeting was a symposium arranged under the direction of Dr. D. T. MacDougal, director of the Desert Laboratory, Carnegie Institution of Washington, Tucson, Arizona, upon "Co-ordination and Co-operation in Research and in Applications of Science," at which the following addresses were given:—"Science and an Organised Civilisation," W. E. Ritter; "The National Research Council as an Agency of Co-operation," A. A. Noyes; "Plans for Co-operation in Research among the Scientific Societies of the Pacific Coast," J. C. Merriam; and "The Application of Science," W. F. Durand. Abstracts of the two written reports of the symposium are subjoined.

The ideals expressed in this symposium were given action in the formation of a Pacific Coast Research Conference, composed of the Pacific Coast Research Committee (which is a sub-committee of the Committee of One Hundred on Research of the American Association), and of representatives of societies affiliated with the Pacific Division. The purpose prompting the organisation of this conference is further expressed in the following resolution:—"Whereas it is the opinion of this conference that the important scientific problems before men of science to-day are those problems relating to preparation for war, which require scientific research, therefore be it resolved that this conference, representing the scientific interests of the Pacific Division of the American Association for the Advancement of Science, offers to the State Council of Defence already formed in California, and to such other similar State or national organisations as may be organised, the full support and assistance of this conference in so far as it may be desired for the direction of research upon problems arising out of a condition of preparation for war."

Science and an Organised Civilisation.[1]

The importance of science in Western civilisation is abundantly recognised. The dependence upon it of agriculture, manufacture, commerce, hygiene, medicine, war, etc., gives it an enormous and secure place in all modern society. Questions of its becoming still more serviceable in these ways no longer concern the fact and general principles of its usefulness, but only matters of its financial support, its special agencies and methods, and its further specialisation and organisation. My commission is to speak about science not so much as an element in civilisation as an interpreter of, and a general contributor to, the very essence of civilisation itself. The propositions supported are:—

(1) That in a catastrophic time like the present, when the social and political conventions and practices and ideas by which civilisation is guided under normal conditions are largely shattered, men are thrown back on the basic principles of their natures to a degree not approximated at other times.

(2) That such conditions are exactly those for science to take cognisance of, and to bring its methods and accumulations of knowledge to bear upon, to the end of making the new *régime* which shall supervene more in accord with the basic principles of man's nature than were those of the old *régime*.

(3) That the scientific men of the Americas, particularly of the United States, are specially well circumstanced to take a leading part in such a movement from the fact that their Governments and special institutions are avowedly (as through the Declaration of Independence, the organic law, and the Monroe Doctrine of the United States) based more on the fundamental nature of man than on political and social tradition.

(4) That in view of this it is the duty of American men of science to exert themselves to the utmost to secure due recognition and participation of science in the gigantic problems of national and international readjustment by which the world will soon be confronted.

The Application of Science.[2]

There are two fundamental motives determining interest in science: (1) a desire to know the universe, its constitution, phenomena, and laws of evolution; and (2) a desire that the facts disclosed may be applied to the service of humanity.

The broadest significance of a fact of science is only reached when it is applied to some useful end. Without such application its significance is limited to its intellectual or æsthetic appeal. With such application it takes its place as one of the factors in the life of humanity.

Not all facts of science are equally susceptible of useful application. Some possibly may have no such application. It is impossible to foresee the future, however, and it is not unreasonable to assume that, in a large way, all facts of science contain the potential of some useful application at some stage in the evolution of humanity on the earth.

The problem of the application of the facts of science is that of bridging the gap between the observed fact and the correlated demand presented by the needs of civilisation. This problem divides under two types. (1) Given a fact of science, what are its applications? (2) Given a need of civilisation, what is the foundation in science for meeting the need?

The factors most likely to be of significance in dealing with the first problem are (1) imagination or vision; (2) wide acquaintance with the needs of humanity as expressed in terms of their scientific elements. For the second typical problem there are required likewise (1) imagination or vision, and (2) wide acquaintance with the facts of science likely to bear upon the specific problem in hand.

[1] By William E. Ritter, Director, Scripps Institution for Biological Research, La Jolla, California.

[2] By Prof. W. F. Durand, professor of mechanical engineering, Stanford University, California.