through two lenses was surprised to see an enlarged and inverted weathercock. The discovery was of value for war purposes. Galileo used the telescope to reveal the wonders of the heavens. He died in 1642, the year of the birth of Newton, exemplar of another method of scientific discovery, "travelling through strange seas of Thought, alone". Newton invented the reflecting telescope, the prototype of which is still in the proud possession of the Royal Society. The last—under construction in California—will in due course reveal new heavenly wonders. With apologies to Aristophanes, we may suggest that the frogs of Galvani are the most famous in the world. They hanged by a copper hook from an iron balcony. Galvani noticed that the dead frogs twitched when the wind brought their bodies into contact with the balcony. Thus the galvanic current was discovered, followed by the Voltaic pile, forerunner of the storage battery. Sir Richard Gregory in his book "Discovery" recalls that the Danish professor, Oersted, discovered induced currents by chance during a lecture experiment in 1819. Ampère, the French physicist, suggested that induced currents could be used for signalling at a distance, and two German men of science, Gauss and Weber, invented the first magneto-electric telegraph in 1833, a happy example of international co-operation in science. During Morse's experiments on telegraphy, a mile length of wire alongside a canal broke accidentally. Why not use the water of the canal ? Röntgen and Becquerel were favoured by chance in their important researches.

Iodine was accidentally discovered in 1811 by Courtois in the mother liquor of kelp. In those pre-Mendeléeff days, no chemist would deliberately set about its discovery. Colonel Silver records that ebonite was discovered by the accidental over-vulcanization of a rubber ball. The hypnotic property of sulphonal was discovered by chance. Antipyrine, an invaluable drug, was in a sense a chance discovery. The cyanide industry, of great value to Germany, resulted from the accidental discovery of Prussian blue by Diesbach early in the eighteenth century. That most useful gas, acetylene, was discovered by accident. The American, Willson, and the Frenchman, Moissan, re-discovered calcium carbide in 1892, working independently. Willson heated a mixture of coke and lime in an electric furnace in the hope of obtaining calcium. The resulting grey fusible mass was allowed to fall into a bucket of water and a copious supply of acetylene was produced. Chemists know of the result of a broken thermometer in relation to the oxidation of naphthalene and the synthetic indigo industry. Electro-plating benefited through a workman throwing his comrade's lump of cheese into a vat !

"Webster" defines chance as a supposed material or psychical agent or mode of activity other than force, law, or purpose. Force is as mysterious as space or time ; law in its scientific sense a somewhat fly-blown idol ; purpose in its teleological sense a vague aspiration. Chance relates to statistics, that queen of sciences, sadly contemned during the present War. We daily see provision made at great expense for war contingencies without regard to the principles of statistics and insurance. Nevertheless, physical science teaches that the most improbable events may happen. Stunned and stupefied by the wonders of modern science, the humble disciple is almost forced to the apostasy—*Credo quia impossibile est.* Was Newton a freak of Nature, due to some capricious combination of genes ? Will the world be reduced to chaos by fortuitous collisions of electrons thrown out of their orbits ?

Let us light a candle to the goddess of chance for boons received, for perils avoided !

Chance of chances, all is chance, says the Preacher. In a milligram of radium, about 500 million atoms disintegrate every second, each giving its characteristic radiation. How are these selected for destruction ? Not by seniority nor by lot like shipwrecked mariners on a raft, says Sir James Jeans in his new book, "Physics and Philosophy". Are we offered an escape from determinism, from "the forbidding materialism of the Victorian scientist" ? In the substratum below space and time, Jeans suggests, there may be springs of events including our own mental activities. The world made safe by democracy ! Chance may be "the unsearchable dispose of highest wisdom". *Quien sabe ?*

OBITUARIES

Dr. F. S. Sinnatt, C.B., M.B.E., F.R.S.

THE death of Dr. Frank Sturdy Sinnatt on January 27 at the comparatively early age of sixty-two has removed from the ranks of technical science one of its important figures. He was director of fuel research to the Department of Scientific and Industrial Research, succeeding Prof. C. H. Lander in 1931.

Born in Jersey in 1880, Sinnatt was educated in Manchester, graduating M.Sc.(Tech.) in chemistry from the College of Technology in 1901. He obtained his D.Sc. at Manchester in 1930 and was elected a fellow of the Royal Society in 1935.

Originally a lecturer in organic chemistry under Sir William Pope, Sinnatt became interested in coal at an early stage in his career, and from personal research extended his work on the subject by organizing lectures in fuel technology and interesting university students in this relatively new branch of science. Coal technology fascinated him and soon absorbed his entire scientific interest. His researches and lectures attracted the attention of the local coal owners, and in 1918 he organized with them the Lancashire and Cheshire Coal Research Association and eventually became its first director. In 1924 he was appointed by the Department of Scientific and Industrial Research as assistant director of fuel research and as superintendent of the Fuel Research Coal Survey. In 1931 he succeeded Lander as director.

Sinnatt's published papers go back so far as 1906. Two early researches (1923), which are still of academic and technical interest, are the carbonization of coal in the form of fine particles for the production of cenospheres, and the mechanism of the combustion of coal in the form of fine powder. In addition, his method for representing the structure of coal in coal seams is still in use. His papers on the examination of coal in the ground represent the first organized series to appear in Great Britain. His later publications are based mainly upon the work of the Fuel Research Station and the Fuel Research Coal Survey.

Sinnatt was thus not only one of the pioneers of survey work in coalfields, but also it is mainly due to his efforts that the National Survey of Coal Resources in Great Britain is so far in advance of coal surveys started in other countries. The records of the Survey have proved invaluable in war-time in defining the properties of industrial coals and in serving as a basis for allocating these coals to their most appropriate industrial purposes. In general research work also Sinnatt's fertile imagination and infectious enthusiasms were an inspiration and example to his staff.

Sinnatt's interests, however, were not limited to his own organization, since he played an active part in the work of other scientific bodies. He served on the councils of the Institution of Mining Engineers, the Institute of Fuel, the British Colliery Owners' Research Association and the British Coal Utilisation Research Association, and he was a member of the British National Committee and Executive Committee of the World Power Conference. In addition, he was a member of the Iron and Steel Industrial Research Council and chairman of the Blast Furnace Scientific Panel. He was also an original member of the Coal Research Club, an informal group of coal technologists formed just after the War of 1914–18 to further coal research and with the special object of prediscussion of papers intended for publication. In forming this Club he was associated with other personalities well known in fuel technology such as Lessing, Stopes, Wheeler and Seyler. In all these wide activities Sinnatt's opinions and views were greatly appreciated.

Although in later years Sinnatt used up all his energies in the pursuit of science, he had had diverse interests in early life, of which the most important was military training. He joined the Territorial Army in 1908, went to France as a member of the Special Brigade, R.E., in 1915, and later, when forced on medical grounds to return to Great Britain, he assumed command of the University of Manchester O.T.C.

His enthusiasm and kindly personality will be sadly missed by the many people with whom he came into contact, and particularly by the staff of the Fuel Research Organization. J. G. KING.

Prof. Rudolph Abel

NEWS has reached Great Britain of the death on his seventy-fourth birthday of Rudolph Abel, professor of hygiene at the University of Jena. Born on December 21, 1868, in Frankfort-on-Oder, Rudolph Abel worked as assistant in Loeffler's laboratory at Greifswald, becoming *Privat-Dozent* in 1893, and afterwards in 1896 assistant at the Institute of Hygiene in Hamburg.

Abel devoted himself particularly to problems more directly concerned with hygiene, publishing many papers dealing with public health and the measures to be taken in combating such diseases as diphtheria and smallpox. He was drawn into the discussion that took place after the War of 1914–18 upon the effect which mass anti-typhoid inoculation of the male population had upon the relative incidence and mortality of typhoid in males and females in subsequent years. The rates for males were found to be very definitely lowered in comparison with those for females, and in this way a reliable indication of the lasting prophylactic effect of the war-time inoculation was obtained. He was consulted as an authority in the judicial trial which followed upon the tragic infections that occurred in Lübeck after the use of Calmette's B.C.G. vaccine.

As a *Privat-Dozent* at Greifswald under Loeffler, a chief whose name, with that of Klebs, will always be associated with the discovery of the diphtheria bacillus, Abel very naturally took a prominent part in the investigations of a number of problems concerned with the natural history and epidemiology of this important organism. The ground for further progress had been recently greatly cleared by Behring's discovery in 1890 of diphtheria antitoxin. Perhaps the most important discovery by Abel in this field was the demonstration in 1894 of the presence of diphtheria antitoxin in the blood of normal persons. This observation underlies much of the present-day practice of immunization against diphtheria. In the blood of diphtheria convalescents Abel found no antitoxin at the time of disappearance of the membrane, but some ten days later antitoxin appeared, only to vanish in the course of succeeding months. He made the suggestion, abundantly verified in recent years, that it is not the mere presence, but rather the amount, of diphtheria antitoxin in the blood that determines immunity.

To the carrier problem in diphtheria Abel made important contributions and also to the importance of fomites as potential sources of infection; in 1893 he had isolated virulent diphtheria bacilli from a box of bricks 6½ months after a child suffering from diphtheria had played with them. Another problem that greatly interested Abel while in his twenties at Greifswald, and to which he devoted a series of bacteriological contributions, was the etiology of certain nasal conditions, in particular ozæna or atrophic rhinitis associated with the presence of organisms of the mucoid-encapsulated group, of which the prototype is Friedländer's bacillus. In his article on these organisms contributed to "Kolle and Wassermann", and to the third edition of this work edited by Kolle, Kraus and Uhlenhuth, he strongly maintained the view that from the very start of the condition of atrophic rhinitis with its accompanying ozæna, an organism found by him and known as the *Bacillus mucosus ozœnæ* played a causative part. Writing in 1938, he had to admit that his view of the etiological role of 'Kapselbacillen' in the causation of the ozæna process had not gained the acceptance of rhinologists, and indeed the precise part played by this interesting group of organisms in disease has scarcely yet been adequately elucidated.

To the great compendium of current bacteriological knowledge already alluded to, Abel provided the first chapter, dealing with the historical development of our knowledge of infective immunity throughout the centuries to the time of Pasteur. It is a concise account and should be read in conjunction with the detailed and fully documented study of this theme by Bulloch in his "History of Bacteriology", published in 1938.

After some ten or twelve years of research on pressing bacteriological problems, Abel became more interested in those of general hygiene in its relationship to the State, and he wrote widely on a variety of public health questions. In so doing he departed to some extent from the Koch tradition, which made it almost imperative that holders of chairs of hygiene in German universities should be predominantly exponents and practising professors of bacteriology. For this reason and in view of the fact that his work on bacteriology occupied only his earlier years, Abel's achievements are probably less known to present-day bacteriologists than those of many of his contemporaries who have occupied chairs of hygiene in Germany since the beginning of the present century.

He will, however, be chiefly remembered in Great