always found in theoretical descriptions, is open to obvious objections. The most illuminating model of such cases appears to be that of surface disturbances in an infinitely deep and highly viscous fluid. This analogy has been studied mathematically by Bose.[4]

The design of channels is determined primarily by the amount of silt which they must carry and discharge on the irrigated fields if the system is to remain working. The transport of silt by water in turbulent flow, both as it affects the intake from the river at the headworks, and the regime of the canal, still awaits scientific description. With the problems which arise in the design of irrigation works, in which model experiments, under properly adjusted conditions of dynamical similarity, alone enable three dimensional problems to be solved, enough will have been said to indicate the scope awaiting the application of mathematical and physical research.

A word may be added on the agricultural problems which are inseparable from questions of irrigation. Excessive irrigation and its evil effects have been mentioned, and may be regarded as a Scylla, between which and the Charybdis of the development of salinity, a safe course must be steered. With sparse rainfall the salts carried in irrigation water may accumulate in the soil, so that a too parsimonious economy of water, or reversion to well-irrigation without adequate replenishment of the water-table with fresh water, must result in a continuously increasing salinity of soil and ground water. It would appear that the only permanent solutions which can be looked for in the flat alluvial plains now considered, will be a combination of irrigation and drainage; in fact, it would be safe to state that any modern system of irrigation in alluvial plains must be designed at the outset with full provision for adequate drainage.

Very much therefore remains to be done in designing effective remedies for existing systems and in the physical and chemical questions of reconditioning damaged soils.

[1] Lindley, *Punjab Irrigation Branch Papers* No. 31.
[2] Wilsdon and Sarathy, *Punjab Irrigation Research Memoirs*, vol. 1, Nos. 1 and 2.
[3] R. A. Fisher, *Phil. Trans.*, B, **213**, 309; 1925.
[4] N. K. Bose, *Punjab Irrigation Research Memoirs*, vol. 2, 1929.

Obituary.

SIR GEORGE WATT, C.I.E.

THE death of Sir George Watt removes a figure who did valuable work for India, from which he retired nearly a quarter of a century ago. He will be always remembered for his "Dictionary of the Economic Products of India". Few would dispute the very great value on Indian economic development which has resulted from this publication.

Watt was born at Old Meldrum in Aberdeenshire in April 1851, the third son of John Watt. He married in 1873 Jane, elder daughter of Robert Simmie, who was Customs and Excise Officer at Lossiemouth. A son, Dr. R. H. Watt, and two daughters survive him. Watt was educated at the Grammar School and Marischal College, Aberdeen, and then went to the University of Glasgow in 1871, graduating M.B. and C.M. He had obtained distinction in botany, and this led to his appointment in 1872 as professor of botany in the University of Calcutta, a post he held for twelve years. In 1882 he was appointed scientific and medical officer on the Burma-Manipur Boundary Commission. His work and enthusiasm were beginning to attract the notice of the Government of India, and in 1883 Watt was appointed to the charge of the Indian Section of the great International Exhibition held in Calcutta in that year. The following year he received the definite appointment of assistant secretary for scientific purposes to the Revenue and Agricultural Department of the Government of India. In 1885 he went home and held charge of the Imperial Indian Economic Court of the Indian and Colonial Exhibition, an exhibition which fired the imagination of the public school youth of the day.

By this time Watt appears to have convinced himself of the grave existing need for a better knowledge of, and comprehension of, the value of the enormous number of what, *faute de mieux*, were termed the economic products of the country. He was able to impress the Government of India with his views, and in 1887 was appointed Reporter on Economic Products to the Government, a new post. It has been said that Watt had been turning his attention to this question of the economic products of the country and he had commenced in 1885 collecting material for the compilation of a dictionary on the subject. With his official apointment he was able to take up this project seriously and by 1894 the nine fine volumes of the "Dictionary" were completed. The work was a standard one and, unfortunately, owing to the unexpected demand, went out of print at an early date.

When Watt compiled the "Dictionary" there was no Agricultural Department to the Government of India, no Pusa and no Forest Research Institute at Dehra Dun. Watt's project was invaluable but, with no idea of belittling his magnificent work, it should be stated that the "Dictionary" would never have seen the light of day had it not been for the loyal, intelligent, and enthusiastic assistance accorded to him by collectors and deputy commissioners of districts and their staffs, and by the forest officers throughout the country; and the latter, owing to their training in scientific method and deduction, were perhaps in a better position to submit reports in a readily utilisable form. Many, if not most, of the inquiries originated with Watt, and circulars were issued asking for co-operation in instituting investigations and often in carrying them to a conclusion, where practicable, out in the districts. There is little doubt that Watt's initiative in this respect aroused the interest of many junior officers in this matter of economic products.

I had not been three months in India before a conundrum in one of the circulars was given me to deal with, and several most interesting months were passed in endeavouring to submit a satisfactory solution.

The "Dictionary" was not intended as a text-book or handy handbook, but it was a first definite departure in the study of the economic products and served as the basis for the great development of this study which has since come about. Watt retired in 1906, but the post of Reporter was not finally abolished until both the Pusa and Dehra Dun Institutes were firmly established. Watt's ledger files, which he had maintained over a long period of years, were then made over to these latter. He had also edited an invaluable publication known as the *Agricultural Ledger* from 1892 to 1903, which was continued by his successors. He was also in charge of the industrial section of the Indian Museum at Calcutta.

It was during Lord Curzon's Viceroyalty, to some extent due to the fact that the "Dictionary" was out of print, that Watt was asked to prepare, with the guidance of a small expert committee in London, an abridged edition of the "Dictionary", to be brought up-to-date and to be issued in one volume. This work, under the title of "The Commercial Products of India", was published in 1908.

Watt was president of the Pharmacological Section of the Indian Medical Congress in 1894. In 1901 he was appointed to the Indigenous Drugs Committee, and as secretary drafted the report. In 1903 he organised an Indian Art Exhibition in connexion with Lord Curzon's Delhi Durbar.

After his retirement from India, Watt made a special study of cacao cultivation, visiting Portuguese West Africa for the purpose in 1912, and patented machinery for cacao manufacture. He served for five years as lecturer in the botany of Indian trees at the University of Edinburgh. He was made C.I.E. in 1886 and was knighted in 1903; he was LL.D. of both his old Universities, Aberdeen and Glasgow; a fellow of the Linnean Society; and had received distinctions from a number of foreign universities and scientific societies.

In addition to the "Dictionary", Watt published "Pests and Blights of the Tea Plant"; "Rhia and China Grass"; "Lac and Lac Industries of India"; and an important work on the "Wild and Cultivated Cotton Plants of the World".

Watt had settled at Lockerbie in 1910 and identified himself closely with local affairs, serving on the Dumfriesshire County Council and Education Authority. His death on April 2 will be much felt by many, and not least by the band of men who were identified, one way or other, with his valuable Indian work. E. P. STEBBING.

PROF. I. P. BORODIN.

PROF. IVAN PARTHENIEVITCH BORODIN, whose death at Moscow was recently announced, was a botanist and forester of international reputation. Born at Novgorod in 1847, he was educated at the University of St. Petersburg, where he became professor of botany in 1887, a position he held for three years. He then became professor at the St. Petersburg Forest Institute, where he continued for thirty years. This was formerly the largest and probably the best equipped forestry school in Europe, and many foreign students were attracted to it by the prestige of Borodin and the scientific staff. In 1897 he founded the biological freshwater station which bears his name and of which he was director.

Borodin's first researches were on the effect of light on the higher cryptogams, and he also worked on respiration. An early paper, however, on botanical progress during 1877–79, indicated the catholicity of his interests shown later by his publications on mycology, anatomy, reproduction, and biochemistry. He also wrote standard books on botany and agriculture.

The study of botany in Russia owes much to Borodin's zeal and versatility, and this is shown by the numerous honours conferred upon him. He was of strong physique and enormous energy, attributes which served him in good stead in the arduous botanical travels he undertook in the remoter parts of Siberia and the Caucasus. His interest in travel continued to the end, and he served as president of the standing commission for the development and exploitation of tropical countries. He held several other positions to which the term honorary is usually applied, but Borodin devoted himself to his duties with intense earnestness and clear thinking enthusiasm. He was a man with many friends in his own and in other countries.

PROF. HERMAN VON IHERING.

PROF. HERMAN VON IHERING, who died at Büdingen in Oberhessen on Feb. 24 in his eightieth year, is well known from his contributions to the biology and palæontology of South America, where he was for many years Director of the Museum at São Paolo, Brazil.

Von Ihering was especially interested in zoogeography and in order to test its problems by various groups of animals, specialised on land and freshwater mollusca and on the social insects, especially the wasps. He had also a good knowledge of the South American mammals, recent and fossil. He also wrote on the Antarctic faunas, the German Selachians, and the fossil and living mollusca of South America. He was a man of original and independent views and was often engaged in controversy, on one occasion with Ray Lankester. He was a pioneer in the application of parasites to zoogeography and it is often called "the von Ihering method".

Von Ihering wrote many memoirs on the anatomy and classification of the land mollusca and on the biological relations of South America His last general work was his "Die Geschichte der Atlantischen Ozeans" (June 1927), wherein he summarised and restated his former conclusions, and advocated fundamental changes in both Atlantic and Pacific geography up to the middle of the Kainozoic era.