tion of the Mackenzie River covers a very large area, extending for hundreds of miles along the direction of the river. In the reported words of a geologist who accompanied the drilling party this year, "the biggest oilfield in the world is what has now been opened in the north."

Before this great oilfield can be made commercially profitable there are, of course, many difficulties to contend with, especially the long distance from civilisation, the severity of the Arctic climate, and the lack of adequate transportation. But as these obstacles did not prevent the exploitation of the gold in Klondike, we need have little fear but that this precious fluid in the Mackenzie valley will be won.

Several of the Canadian Geological Survey Memoirs describe the Mackenzie River district, though they do not enlighten us much on the subject of petroleum, which was the special object of the Bosworth expedition. The most interesting

of these is the report by Mr. R. G. McConnell, published in 1891, which mentions the bituminous rocks and pools of tar and oil, which he observed in many places. Memoir 108, on "The Mackenzie River Basin," by Messrs. Charles Camsell and Wyatt Malcolm, which appeared in 1919, also cites particularly the oil indications which Mr. McConnell had found, some of which had been noticed also by Sir John Franklin a century ago. This official memoir is very guarded on the subject of petroleum, and does not afford great encouragement to oil prospecting on the Mackenzie; but it is a comprehensive summary of the previously established facts, together with many valuable observations, old and new.

During the next few months there can be little or no progress made with the development in this frozen land, but doubtless many preparations are afoot, and next spring will see an unprecedented migration of oilmen to this northern clime.

Industrial Research Associations.

V.—THE BRITISH PORTLAND CEMENT RESEARCH ASSOCIATION.

By S. G. S. PANISSET.

ALTHOUGH the Portland cement industry had its origin in this country, the chief developments have occurred elsewhere, and the greater part of the manufacturing plant now in use is either of foreign production or a close copy thereof.

It may be disputed that this position has arisen from the absence of organised research in this country, but it is certainly true that the amount of scientific investigation in the British Portland cement industry has been insignificant compared with the work done in the United States and on the Continent.

With these circumstances existing, it is clear that the British Portland Cement Research Association is a needed institution, and it is some comfort to know that its arrival is not too late to be effective. The extent of the field of research still awaiting exploration is such that no agreed answer can be given to the fundamental questions, "What is Portland cement?" and "What happens when cement sets?"

In spite of the extensive research that has been conducted in the United States by Government institutions and by universities, the real nature of cement, and the chemistry and mechanism of its setting, are still matters of controversy, owing to the lack of concrete evidence.

The manufacture, in fact, is still in the empirical stage, based solely upon the knowledge that a mixture of calcareous and argillaceous materials containing about 76 per cent. of carbonate of lime will, when heated to incipient vitrefaction, yield a product which on grinding has pronounced hydraulic properties. Whether the hydraulic effect is due to the presence of simple silicates and aluminates of lime, whether complex

ternary compounds exist, or whether a part of the lime is uncombined and in the state of solid solution, are all problems which must be solved before it can be claimed that the best possible constructional material is being produced.

In connection with the setting of cement, it is still undecided whether this is due to colloidal or to crystalline action, and the manufacturer is accordingly in the dark as to whether he ought to be aiming at the production of colloids or of crystalline bodies to produce the best results.

The composure of manufacturers has now and again been disturbed by predictions that cement can be made from a mixture containing only two-thirds the conventional proportion of lime, and again that the stage of incipient vitrefaction now produced in rotary kilns can be improved upon by adopting blast-furnace methods and carrying the temperature to melting point. From the point of view of scientific knowledge the manufacturer is unable to deny that such statements are within the range of possibility, and hence there is always the fear that more than half the present cement-making plant may be rendered obsolete by new discoveries.

This is not a happy position for an industry, especially when such a discovery is likely to be the property of those who have hitherto been foremost in research—namely, the foreign competitor—and in this connection the advent of the British Portland Cement Research Association is not a day too soon.

Again, if it be supposed that the present methods of manufacture are permanent, the fact has to be faced that the thermal efficiency of the kilns in use is seldom more than 50 per cent., and here is a field for research that may lead,

upon cultivation, to a reduction in the cost of production. The importance of the matter to an industry consuming $1\frac{1}{2}$ million tons of fuel in a year can be readily appreciated.

It is obvious, therefore, that a very wide field lies before the British Portland Cement Research Association, and the scope both for scientific and for industrial research is ample warrant for the existence of the association for some years to come.

The British Portland Cement Research Association was incorporated in November, 1918, and had the advantage of being founded upon the research department of the two largest cement manufacturers in the country. This research department had been in existence for five years, and had gathered together an experienced staff and a valuable equipment of scientific apparatus, while the large amount of spade-work that had been done has proved of great value to the association. Both staff and equipment were taken over entire, so that no time had to be spent in organisation, and research was in progress from the first day of the association's existence.

The council of the association has addressed itself in the first instance mainly to the industrial side of research, and the chief activity has been the investigation of the thermal efficiency of rotary kilns. The basis of this investigation has been the fact that the consumption of fuel in an ideal kiln for cement calcination would be no more than 15 per cent., compared with the 30 to 40 per cent. consumptions which are prevalent in actual practice to-day.

Another prominent subject of investigation has been the mechanics of pulverising and grinding, and the importance of this will be realised when it is stated that, as a rule, the production of Portland cement involves reducing to powder three materials with a total weight three times that of the final product, the power so absorbed ranging from 60 to 150 h.p.-hours per ton of cement.

A feature of investigations of this nature has been the commercial scale upon which they have been undertaken, involving the presence of the research staff of engineers and chemists upon the factories of one or other of the members of the association, and this intimate connection with the practical side of the industry has been of value in preventing research becoming too academic and too far removed from practical issues.

The purely scientific side, however, has not been neglected, and in the laboratories of the association at Greenhithe researches upon the setting of cement, the influence of raw materials upon cement, and other chemical subjects are in progress, while an experimental grinding mill has also been set up in the laboratory.

The aim of the association may be briefly summarised as an attempt to cheapen the production and to improve the quality of cement, and the achievement of this aim cannot fail to benefit the consumer while tending to stabilise the British industry.

The hearty co-operation of British manufacturers in this enterprise is shown by the fact that more than 90 per cent. of their number are members of the association.

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Obituary.

SIR WILLIAM ABNEY, K.C.B., F.R.S.

ANOTHER of the conspicuous leaders of British science who rendered the latter part of the nineteenth century and the commencement of the twentieth so famous as a time of remarkable progress, and whose name was almost a household word throughout the land, passed away on December 2 in the charming and unique personality of Sir William de Wiveleslie Abney. Sir William Crookes, Sir Norman Lockyer, and now Sir William Abney—the recent months have indeed been heavy with fate for that glorious band of scientific workers, and the only consolation that these severe losses in the front rank leave with us is the knowledge that their great work was done, that their last paper was written with all their full mental powers, and that they passed away, at a ripe age truly, but before any failure of their great master minds became evident to the world at large.

Sir William Abney will ever be remembered, especially under his better-known earlier designation as Capt. Abney, for four things in particular: for his great services to the nation and to the cause of science in the Department of Science and Art at South Kensington; for his researches

on the infra-red of the spectrum, leading on to his masterly use of the spectrum in regard to colour vision and colour measurement; for his development of photography into an exact science; and for his studies of the forms of ice and snow in the high Alps. Those of us who had the great privilege of attending his lectures on colour and its measurement at the Royal College of Science, where for many years he was occasional lecturer in physics, will ever regard those hours as among the most delightful and thoroughly enjoyable ever spent in a lecture-room. They were brilliant, not for what was said so much as for what was done, for the experiments were ever most elegant, beautiful, and even exquisite as regards the phenomena exhibited, and marked by an originality which was the direct outcome of a most original mind. It was a still greater privilege to be able to follow him into his research laboratory, and to see something of the most fascinating experimental work going on there, with the aid of his devoted assistant, Mr. Walter Bradfield, and which at frequent intervals resulted in a paper to the Royal Society, of which Sir William was elected a fellow so early as the year 1876.

Yet perhaps the most charming side of Sir