

The Committee was in obvious difficulty in suggesting a limit for the irradiation dosage that could be received by the population as a result of waste disposal, in that "there is no agreed permissible genetic dose and there is no agreed allocation of dose to the different ways in which the population is irradiated". Whatever the research effort, it is difficult to imagine a quick answer to this problem. For immediate use, it would appear reasonable to suggest limits, as the Committee has done, which are considerably less than those which informed medical opinion regards as maximal. The report also indicates the need for considerable research in a number of other fields where information is lacking. Thus, when speaking of the discharge of liquid wastes to rivers, the Committee comments that "we know all too little of the absorption on river muds, the absorption into weeds and the take-up by grass". A research inquiry would appear to be required to establish the fate of radionuclides disposed of in sewage systems. It should not be impossible to ascertain what proportion of radionuclides, particularly those such as radiostrontium which are taken up by plants, pass through sewage disposal works and what proportion is retained in the sewage sludge, which may be used as a fertilizer. The report warns of the need for further research before highly active fission products produced as waste from the processing of fuel elements be dumped into the sea. The repeated reference to the lack of experts with the knowledge to deal with the problems of waste disposal poses the question as to whether adequate steps have been taken to ensure the training of sufficient personnel for the efficient working of the proposed central authority.

## GEOPHYSICS FOR THE ENGINEER

Geophysical Surveys in Mining, Hydrological and Engineering Projects, 1958

Pp. viii + 270. (The Hague, 30 Carel V. Bylandtlaan : European Association of Exploration Geophysicists, 1959.) 16.50 florins ; 4.50 dollars.

THOSE who have followed the growth of geophysics since the early 'twenties will remark the happy circumstance that has allowed the publication of this excellent volume of case-histories to occur during Prof. J. M. Bruckshaw's term as president of the European Association of Exploration Geophysicists. Prof. Bruckshaw was a member of the original team which, under Broughton-Edge, produced one of the classics of applied geophysics, based on tests of all the different physical tools against a series of geological structures in Australia.

When it became apparent that geophysical methods could locate potential oil reservoirs, the oil industry application swamped all others. There has been a tendency, as with oil-well drilling, for the tools to be elaborated instrumentally, but, as Prof. Bruckshaw pointed out in his presidential address to the European Association of Exploration Geophysicists, there have been no fundamental changes in the methods that were developed thirty years ago. It is possible that present geophysical methods in the oil industry have already been pushed beyond their economic limits,

and it may be opportune to take another look at how the mining and civil engineers use geophysics.

The engineer, whether looking for ore-bodies, locating water-supplies or studying the foundations of buildings or dam sites, cannot afford the luxury of rapid coverage of large areas with routine magnetic, gravity and seismic measurements. He must find the most suitable tool or combination of tools—including the drill—to solve his geological problem. In one respect, of course, the technical problems of the engineer are simplified, since all his underground structures are much shallower than most oil reservoirs, and often cheap and rapid electrical prospecting methods are adequate. However, the case-histories do show a proper appreciation of how geophysical tools should be used in geological work, as, for example, in some of the Phone valley investigations, where electrical surveys were supplemented by seismic refraction measurements.

It is instructive to the oil geophysicist to read of the wide variety of successful applications of geophysical methods. In Yugoslavia, for example, ancient Roman mining activity is being extended by the exploration of a whole zone of electrical anomalies. In Finland, swamp-covered ore deposits are revealed by magnetic and electromagnetic surveys. The search for uranium-vanadium ores in Colorado in 1940 led to the use of the Geiger counter as a new prospecting tool. It is pleasant also for those who have spent a great deal of time listening patiently to the claims of water diviners to see that great success has been achieved in the State of Illinois by using resistivity surveys to locate comparatively small pockets of water-bearing sand and gravel. The drill has shown that in hundreds of surveys the interpretations are 90 per cent correct, a better result than can be obtained by divining.

This collection of past experience should prove of great benefit to civil engineers, since there are many cases, such as the proposed Channel Tunnel or the new Forth Bridge, where the application of geophysical methods can supplement and extrapolate the information obtained traditionally by boring.

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## ELEMENTARY PARTICLES

The Theory of Elementary Particles

By Dr. J. Hamilton. (International Series of Monographs on Physics.) Pp. xii + 482. (Oxford : Clarendon Press ; London : Oxford University Press, 1959.) 75s. net.

IT must be said immediately that this is not a narrative book that aims to introduce one to elementary particles or indeed to interest one in them by persuasion at all. It is a book for the professional which deals with the mathematical formalism and techniques that have been found useful for our description of elementary particles and their interactions. The particles themselves, of course, figure and are the subject of a table at its end. They are used, however, rather more to illustrate the formalism than as the subjects of the work itself. The formalism presented is 'useful' in the sense that it is of immediate application in our everyday handling of the elementary particles. There is very little attempt to discuss mathematics in a quasi-philosophical framework as a source of concepts. In other words, this is a book