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Book Review

Geothermal Energy Utilization
E. F. Wahl, John Wiley, New York, 1977, 470 pp., £16.50 or $27.95

With the existing public debate and interest in energy sources this book is a topical and useful addition to the field. However, it cannot be considered a general introduction to this world wide and, to the uninitiated, seemingly inexhaustible supply of energy. It is a specialized technical assessment of the problems involved in extracting this energy.

To be economically viable energy must be removed from any zone at a rate of more than 10 W/m^2 but, as the heat flow in the crust only very rarely exceeds 0.5 W/m^2, the lifetime of any plant is limited; the reserves therefore, are not inexhaustible. Some idea of the seriousness of the problems involved in using this heat can be realised when these heat fluxes are compared with the solar heat flux at the surface which is of the order 100 W/m^2.

The first chapter is a general introduction to the field and would be of interest to all with any concern for the future of mankind's energy resources. The amounts of geothermal energy available in different parts of the world are given demonstrating that in narrow specific zones, the world's geologically active regions (the tectonic plate boundaries), it is greater than twice that in the remaining, inactive, areas of the world. Theories of heat generation and transport are considered and it is shown how much higher temperatures can be found nearer the surface (and therefore can be more easily tapped) in the active zones. Existing geothermal plants for the extraction of this energy are listed and the general conclusion is: "that exploration, research, development and utilization of geothermal energy will increase considerably in the forthcoming decade".

The following four chapters deal in great detail with the physical and chemical properties of brine. In some parts of the world brine naturally transports the heat of the surface but would have to be introduced artificially if geothermal energy is to be utilized in any other zone. The solubility of various rock constituents and their effects on the acidity of the brine are considered together with the more practicable problems of corrosion and scale deposition and their minimization.

Three chapters deal with the conversion of the heat to electricity. Turbines and expansion engines are compared and some idea of the capital operating costs for a 110 MW sized plant are given. These are followed by a chapter dealing with the direct utilization of the thermal energy and the extraction of minerals from the brine. This chapter also considers the costs as well as the technical problems involved in setting up one of the existing plants in Iceland.

The final chapter compares the uses and performance of combined systems and the general conclusion is that in the ideal system one must produce electricity and use the reduced grade heat for space heating. However, where both are not possible it is thought that space and process heating will provide the maximum return for any system.

This reviewer liked the layout of the book which contained many clear and useful diagrams. In addition the presentation of much of the data in tabular form not only made for a much clearer understanding but will make future information retrieval far easier. Reading the book was hard going in many places as a range of topics in geology, chemistry, physics and engineering were covered in detail. However, ending each chapter with a brief summary of the main points proved to be a most useful practice. The policy of ensuring that all nomenclature and symbols were listed at the end of each chapter in which they were used was also appreciated. One relatively minor criticism was the use throughout the book of a variety of units, *e.g.* °C and °F (on Figs. 2.8 and 3.7 one only finds °). In the preface the author does explain that this variety is deliberate to ensure that in each section are found the units most familiar to the person interested in that section, *i.e.* metric for the geologist/chemist; Btu/lb etc. for the practising engineer. However, it is felt that it would have been better to be consistent throughout.

Any book covering the range of expertise and amount of detailed data that this one does must rely on a great number of sources. This one is no exception and the author concludes each chapter with an excellent list of references which not only give the sources of the data but also provide a useful spring board from which the reader may select additional reading matter according to this inclination.

One thing one would have liked was more information on how the geothermal energy in the inactive areas of the world can be tapped. These are neglected being, admittedly, much less attractive economically. However, it is in these areas where most large centres of population exist and where the need is greatest.

It is claimed that this is a book intended for the professionals as well as for the student. I must concur with this although it may be expensive at £16.50 for the latter.

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