

eighties: scientific categories had not altered in centuries (the term "biology" was not recognized before 1976) and the Government had not, it seems, asked the Academy for any official advice since 1917. Aigrain describes the very limited reforms, including an effective rejuvenation of the membership, he was able to push through against the concerted resistance of the Establishment. This chapter incorporates a critical comparison of Academies in several countries.

Another first-hand account by Aigrain deals with the early days of the Délégation Générale à la Recherche Scientifique et Technologique (DGRST), set up by de Gaulle in 1958. This was an interministerial body of scientific advisers, independent of the established civil service, which also had some research funds at its disposal. Its aim was to bypass the rigidity of the French Establishment, especially when the need arose to ease the way for new disciplines, such as molecular biology. There were few permanent staff, and most collaborators were scientists on a few years' part-time secondment. It is a source of some alarm that under the Mitterrand Government, this body (somewhat akin to the Science and Engineering Research Council in Britain) has been absorbed into the Research Ministry, has more permanent staff and is much more subject to the influence of centrally imposed technological objectives: the DGRST increasingly resembles the CNRS, itself modelled at its creation in 1938 on the Soviet Academy of Sciences. The upshot may be that technological-type planning is applied much too rigidly to pure science, and there are already clear signs of this. Aigrain's prediction (in translation) may prove apposite:

It is not impossible that fifty years from now, if the *mal français* persists, we shall end up with a Délégation Générale made up of a special corps of civil servants, graduates of a Grande Ecole created *ad hoc* and dug in for life.

The relationship between the DGRST and the CNRS emerges most interestingly when one reads the two books together; Papon in particular treats very frankly the difficulties of technological planning which both these bodies now attempt. This discussion is worth comparing with Sir Geoffrey Allen's analysis of the creeping intrusion of dirigisme in British science (*J. R. Soc. Arts* 129, 490; 1981).

Both authors, Papon in particular, also discuss the advantages and drawbacks of the French Grande Ecole system and its uneasy coexistence with the universities. Universities are bound to accept all school-leavers who have attained a minimum standard in the baccalauréat, the national school-leaving examination (though about half have to leave without completing their courses), while entry to the Grandes Ecoles, many of which have a mathematical bias, is only by success in a very highly competitive entrance examination for

which two years of intense full-time preparation is mandatory. Because of this, the Ecoles are largely middle-class preserves. However, the universities produce professionals such as doctors and lawyers. The university (French politicians realistically prefer to use the singular) is very closely and directly controlled by the Ministry of Education, whereas the Grandes Ecoles, under a variety of Ministries, have more independence and diversity. The Ecoles produce virtually all the senior civil servants and managing directors of large concerns in France. In spite of their manifold handicaps, the universities do most of the academic research. The Grandes Ecoles have, with some distinguished exceptions, proved durably

resistant to the implantation of research groups; yet they secure the best students and steer many of them towards industrial administration. French industry cannot, it seems, do without them, and on this the two authors, however different their viewpoints, appear to agree.

Aigrain and Papon are subject like all of us to the pull of ideology, yet they present their subjects honestly, warts and beauty-spots included. Both of these books are well worth reading, but the two together are more than their sum. □

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Utility of scarcity

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Noble Gas Geochemistry.

By M. Ozima and

F.A. Podosek.

Cambridge University Press: 1983.

Pp.367. £40, \$79.50.

THE chemically inert character of the noble gases (sometimes known as rare or inert gases), together with their very low abundance in planetary objects, renders them particularly valuable natural tracers for both terrestrial and extraterrestrial processes. It is not surprising, therefore, that considerations of the elemental and isotopic abundances of noble gases are becoming increasingly prominent in geochemical research, as analytical techniques improve.

In recent years the existence of primordial volatiles within the Earth's mantle has been demonstrated using noble gas tracers, and important constraints have been placed on interpretations of the internal structure of the Earth. With the exception of the popular use of argon isotopes in conjunction with potassium as a geochronometer, the number of practitioners of noble gas geochemistry has been small. One can confidently predict, however, that this research area will expand significantly in the coming years and play a more central role in the earth sciences. The publication of *Noble Gas Geochemistry*, the first book devoted to a comprehensive discussion of this topic, is thus particularly timely.

In preparing a text in a rapidly evolving, specialized subject area, there is the inevitable risk that the book will become redundant shortly after publication. The emphasis adopted by Ozima and Podosek in *Noble Gas Geochemistry* ensures that this fate will be avoided. The book is likely to remain a highly relevant introductory text for years to come.

The authors start at the ground floor, and in the first four chapters present the

relevant nomenclature and the basic physical and nuclear chemistry of the noble gases. Although the subject matter of the first chapters necessarily contains a considerable amount of tabulated data, it is rendered palatable by a lucid and easy style of presentation: there is here a great deal of useful, accessible reference data. The same lucid style characterizes the remaining chapters, which systematically deal with the abundance and isotopic compositions of the noble gases in meteorites and in the Earth's hydrosphere, mantle and igneous and sedimentary systems. The layout is somewhat encyclopaedic in style, but this is in fact a positive aid to finding information rather than evidence of pedantry on the part of the authors. These sections are well written, packed with valuable information, and reflect the authors' exceptionally good grasp of the subject material. The last chapter reviews the models of Earth degassing and atmospheric evolution that have been proposed on the basis of the abundances and isotopic composition of noble gases.

If the hallmark of the book is the clarity of presentation — extending beyond the text, with its many poignant comments, to the well-prepared tables and figures — its strongest point is the thorough discussion of the basic principles. At this time the book is well up to date, with an excellent bibliography that includes references to many of the recent developments.

Noble Gas Geochemistry is likely to be invaluable to geochemists and will find wide use as an introduction to the subject for a range of non-specialists at both the undergraduate and graduate level. While it is not cheap, I suspect that many potential readers will have to buy it because the library copy will always be out on loan. Ozima and Podosek have performed a commendable task in producing a text on what they themselves term "the utility of scarcity". □

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