Book Reviews

Creating New Elements

Super-Heavy Elements. Theoretical Predictions and Experimental Generation. Proceedings of a symposium, Ronneby, Sweden, June 1974. SVEN GÖSTA NILSSON and NILS ROBERT NILSSON, Eds. Nobel Foundation, Stockholm, and Almqvist and Wiksell, Stockholm, 1974. iv, 188 pp., illus. Paper, 88 Sw.Kr. Nobel Symposium 27, Physics. Also published as *Physica Scripta*, vol. 10A, 1974.

The creation of new elements in the periodic table is a fascinating branch of nuclear science. In the last 35 years, 13 and possibly 15 new elements heavier than uranium (element 92) have been synthesized—mostly in the United States. In recent years the Soviet Union has become a major competitor, and elements 104 and 105 remain unnamed because of controversy about where they were first produced. The slow climb up the periodic table, however, is drawing to a close. Atomic nuclei exist because the nuclear force operating between nucleons, which holds the nucleus together, exceeds the coulomb force operating between protons, which tends to blow the nucleus apart. For each new element created an additional proton is added, and the stage has now been reached at which the coulomb force is dominant and nuclei fly apart by spontaneous fission before their properties can be studied.

In 1966, as a result of theoretical calculations, a new island of nuclear stability was predicted in the region of atomic number 114. This stability results from including certain shell effects that essentially increase the nuclear force so that it again dominates the disruptive coulomb force. These nuclear shell effects are analogous to the atomic shell structure that explains the periodic table of the elements. Element 114 with an atomic mass of 300 (some 40 mass units heavier than the heaviest element yet known) is predicted by some theorists to live a substantial length of time—perhaps 10^9 years. Its discovery in nature or its production in the laboratory would represent a dramatic and important step in the development of nuclear science.

The symposium of which this book is the proceedings was devoted to the theoretical predictions of, and the experimental searches for, these superheavy elements. Such proceedings by their very nature make few concessions to lay readers, and this one is no exception. Several of the invited papers can be read with profit by nonexperts, however. In particular, a good summary is provided in the introduction by S. G. Nilsson, a member of the organizing committee and an important contributor to the theory of superheavy elements. Subsequent articles by G. T. Seaborg (former chairman of the U.S. Atomic Energy Commission and codiscoverer of most of the known new elements) discussing the predicted chemical properties of several of the superheavy elements, by A. Bohr and B. R. Mottelson (who, along with J. Rainwater, were winners of the 1975 Nobel Prize in physics) discussing some current themes in nuclear research, and two articles, one by G. Herrmann and the other by M. Nurmia, discussing searches for superheavy elements in nature past, present, and future are all of substantial general interest.

To summarize briefly the results of the conference, superheavy elements have as yet neither been found in nature nor produced artificially in heavy-ion-induced nuclear reactions. The theoretical predictions, considerably refined over those of eight years ago, still call for an island of stability near atomic number 114 and atomic weight 298. No plausible mechanisms for the production of these elements during the cataclysmic astrophysical processes in which the present stable elements were synthesized have yet been advanced, however, so their existence in nature is unlikely. Their synthetic production will have to result from laboratory bombardment of heavy-element targets with relatively high-atomic-number ion beams from present or future accelerators. The best combination of ion beam species, energies, and targets to employ is not known. Much valuable tilling of the earth in this fertile heavy-ion field will occur before the few gold coins buried there are found—if indeed they ever are.

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Substrates of Human Behavior

Biogenetic Structuralism. CHARLES D. LAUGHLIN, JR., and EUGENE G. D'AQUILI. Columbia University Press, New York, 1974. xii, 212 pp., illus.

Biogenetic Structuralism has two main themes. First, it discusses the nature of structuralism as a philosophy, and advocates it as the best means of establishing the basic and universal rules that control human behavior. Second, it argues that such rules are embodied in "neurognostic models" that are to a considerable extent genetically determined and must therefore be studied as products of past biological evolution in exactly the same way as the human foot or hand. Both arguments seem to me to be of general and great importance, and the failure of the authors to substantiate their claims and so to convince a wide audience is disappointing.

As I understand it, structuralists attempt to deduce the underlying rules by which complex organization may be generated from simple premises. Such induction is, of course, part of all scientific investigation, but it is peculiarly characteristic of certain areas of science: embryology, for example, has always been concerned to establish the nature of the instructions that control the series of decisions that allow every fertilized egg of a species to generate a structure of extraordinary complexity and yet of precisely similar form. Structuralism as embodied in the writings of Lévi-Strauss has the special additional attraction that it gives a systematic and coherent description of very varied phenomena, such as social organization; it is not always clear, however, how far the hypothetical deep structure that allows such description is actually concerned in the generation of the phenomena. Laughlin and d'Aquili discuss this ambiguity in a section that deserves careful reading.

Clearly it would have been possible to concentrate on psychological and ethological evidence for behavioral universals in man and his near relatives, and thereby expose hypotheses more directly to verification or disproof. Instead, the authors chose to concentrate much of their effort on endeavoring to find the neutral substrates for the "deep structures" postulated by Chomsky and Lévi-Strauss (and even Jung). This may be a justifiable strategy in that the audience that is most inclined to view the infant mind as a tabula rasa is also most familiar with such work, and so most readily convinced by arguments based on it. However, its use is an enterprise of great difficulty, and Laughlin and d'Aquili seem to me not to have been able to carry the self-imposed burden.