The dependence of the Mbuti pygmies on their physical environment in the Ituri Forest of the Congo as well as their ecological interactions with nonpygmy villages is described by Turnbull. Kunstadter contrasts two tribes of Thailand: settlement patterns, land use, degree of cultural identity, and mate selection have contributed to significant differences in population size and gene pools among the Karen and the Lua'.

On the basis of their work in the Andes, Baker and Dutt propose that high altitude should be the ideal situation for measuring adaptation from demographic data. Fecundity is definitely lower and mortality may also be affected at such great elevations. It is intriguing to learn that the sex ratio at birth is apparently elevated among the natives of the high Andes. Laughlin describes the distinctive ecology of the Aleuts, with their dependence on sea otters, which are in turn dependent on sea urchins, and contrasts their culture and population structure with those of the neighboring Esquimo.

The irrigation system of Asia is contrasted with the "shifting agriculture" of the tropics of other continents by Weiner. The 3 million square miles of tropical Asia contain 800 million people, a density of 269 per square mile; the 13 million square miles of tropical Africa, America, Melanesia, Australia, and Oceania contain 300 million, a density of 23 per square mile. The biological structure of tropical peoples is related to the dynamics of agriculture and in turn to the soil. In the closing chapter Boyden examines life in the cities as a problem in ecology. Our species now utilizes in a day about as much energy as is fixed by all terrestrial vegetation in that same time, and the energy flow through our growing urban-industrial network will soon exceed the total available energy. Quite rightly Boyden calls for multidisciplinary research on the biology of man in modern society.

In this wide-ranging but related series of papers social and natural scientists meet and infuse their expertise into one another's disciplines. We are reminded in nearly every selection that ethnography and social organization cannot be separated from biology in wrestling with the increasingly important problems of human population. The book provides a valuable supplement for any interdisciplinary course in this field.

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Galaxies and Quasars

Study Week on Nuclei of Galaxies. April 1970. D. J. K. O'CONNELL, Ed. North-Holland, Amsterdam, and Elsevier, New York, 1971. x, 796 pp., illus. $45. Pontificiae Academiae Scientiarum Scripta Varia, No. 35.

External Galaxies and Quasi-Stellar Objects. A symposium, Uppsala, Aug. 1970. DAVID S. EVANS, DEREK WILLS, and BEVERLY J. WILLS, Eds. Reidel, Dordrecht, and Springer-Verlag, New York, 1972. xviii, 550 pp., illus. $35.60. International Astronomical Union Symposium No. 44.

As both of these volumes represent the proceedings of conferences on very similar subjects (held in April and August 1970, respectively) it may be helpful to compare them. In a nutshell, I would say that *Study Week* (the proceedings of a conference sponsored by the Pontifical Academy of Sciences in Rome) is by far superior. Whereas *External Galaxies* (the proceedings of a conference sponsored by the International Astronomical Union in Uppsala) is primarily a typical collection of brief research reports, *Study Week* contains a smaller number of extended review papers. As almost all of the papers in *Study Week* are of high quality, and the ensuing extended discussion among the participants (all of whom are outstanding) is recorded verbatim, one has a very useful survey of an exciting field.

Galaxies exciting? Yes, ever since Baade and Minkowski showed in 1951 that the Cygnus A radio source is really a distant galaxy, which emits more energy in radio waves (drawing upon energy stored in relativistic particles) than that in the light from all its 10^{11} stars. Before 1951, galaxies were thought to be collections of normal stars—huge and impressive, yes, but nevertheless composed of objects we can understand from a physical point of view—stars. Since that time, we have found that perhaps 1 percent of all galaxies are peculiar, in the sense that their radiation comes from a compact region only a light-year across, is variable in time, and has an unusual spectrum, with much of the energy concentrated in the "exotic" x-ray, infrared, and radio wavelengths, rather than in the usual visible range.

The light from normal galaxies is often called "thermal," to indicate that its spectrum can be matched by summing the contributions of billions of stars of various temperatures. The radiation from each star is approximately that of a blackbody, because the energy generated by thermonuclear fusion in the core of the star interacts countless times with matter on its long journey to the surface, where it escapes into space.

The radiation from peculiar galaxies, on the other hand, has such an unusual spectrum that it cannot be accounted for in this way. All the evidence indicates that it comes from relativistic electrons which are somehow generated in a compact region near the center of the galaxy (the nucleus) and which then radiate at exotic wavelengths by the synchrotron process. In some cases, as much as 100 million solar masses of relativistic particles are needed to account for the observations. The fundamental problem underlying both conferences is: What physical process can generate such huge amounts of energy in such an exotic form as relativistic particles?

Needless to say, neither conference succeeds in answering this question, which has been vexing astrophysicists for 15 years. But *Study Week* is successful in clearly delineating the problem and hinting at possible solutions. Some of the interesting ideas are found in the 30 or so invited review papers, while others were spawned in situ during the recorded discussion. I was particularly struck by the review papers of Ambartsumian, Osterbrock, van der Laan, Sandage, Spitzer, Lynden-Bell, and Wheeler. Sandage shows, for example, that his optical data on peculiar galaxies can be understood if each such object is a composite of two pure types: a normal stellar galaxy and a nonthermal source. The latter seems identical to a quasar. The degree of nonthermal activity seems to be determined solely by the size of the nonthermal source, which in quasars is so large that its emission completely swamps that of the stars. This argument suggests that quasars are embedded in normal galaxies after all.

Lynden-Bell gives a beautiful discussion of a theoretical model, based upon formation of a general-relativistic black hole in the center of a galaxy. The black hole accretes galactic matter at relativistic speeds, the gravitational energy released in the accretion process being radiated away as synchrotron emission.

The informal discussion, edited with great care by the Vatican Observatory hosts, endows *Study Week* with special merit. Again and again, the gathered experts generate fascinating discussions as they ponder the review papers they have just heard. Examples are: Hoyle, Sandage, and Spinrad on the ages of elliptical galaxies, various theorists on Frank Low's interpretation of his infrared data, and Salpeter and Fowler on Hoyle's new theory of gravitation.

Of course the high level of discussion reflects the style of the conference. Highly selected participation (30 people at Rome compared to 170 at Uppsala) and leisurely discourse (30 papers at Rome compared to 82 at the Uppsala, in a similar time period) encourage high-level discussion. My general impression is that the Pontifical Academy of Sciences is very good at this sort of thing, perhaps because it is not obliged to invite everyone to its deliberations. In this case, the comparison between its style and that of the International Astronomical Union is striking. One might put it this way: The democratic approach (Uppsala) lets many specialists hear low-level discussions, while the elitist approach (Rome) lets even more specialists read high-level discussions.

Of course, that is not to say that there is nothing of value in *External Galaxies*. There are 12 review articles of considerable merit (although half of these are by speakers at the Rome conference, and can be read in *Study Week*). Although most of the research papers have by now appeared in the open literature (in the two years it takes to publish such proceedings), there are a few, such as Angione and Smith's study of the variability of quasars, which are both interesting and not easily available elsewhere.

But I repeat, if you can afford only one book on peculiar galaxies, *Study Week* should be it.

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Intricacies of Nomenclature

Crystal Chemical Classification of Minerals. A. S. POVARENNYKH. Translated from the Russian edition (Kiev, 1966) by J. E. S. Bradley. Two volumes. xvi, 766 pp., illus. $40. Monographs in Geoscience.

This work is a bold and full-scale effort to replace the existing systematics of mineralogy by a new nomenclature and classification based on crystallochemical principles. It is a translation, revised and updated by the author, of a work published in Russia in 1966. In brief, Povarennykh is proposing a system of acronyms conveying chemical and structural information to replace the cumbersome and generally meaningless trivial names that have accumulated in mineralogy since the time of Pliny and before. Although Povarennykh has already published several papers on the subject in the periodical literature (that are touched on in this review), and now a book, it would have been preferable if the general matter had first been discussed before a forum such as the International Mineralogical Association. This still must be done before acceptance can be obtained.

Povarennykh's proposal will undoubtedly seem eminently desirable to many persons, especially those working in the crystallographic aspects of mineralogy. The matter, however, is not so simple. The existing nomenclature is traditional and trivial, but it is a response to inherent characters of minerals that render difficult, and in part preclude, a comprehensive rational nomenclature.

The present proposal and the elaborate and forgotten scheme of H. M. Howe, proposed in 1884, take us back to a major turning point in the nomenclature of chemistry. The nomenclatures of mineralogy and chemistry, earlier both of a trivial nature, parted company in 1787 with the publication of the *Méthode de nomenclature chimique* by Guyton de Morveux, Lavoisier, Berthollet, and Fourcroy. This work conceived chemical nomenclature as a *method* of naming chemical substances, rather than as a rigid system of given names, and was based on the idea that the names of chemical compounds should be related to their constituents. The unit of description in inorganic chemistry is a compound of definite and limited composition, an end composition, that is the result of chemical preparatory operations that, in most instances, are based on natural materials of more general composition.

Minerals, on the other hand, in general are polycomponent solid solutions, often of extremely complex composition that usually varies in different geological environments. For instance, in a natural borosilicate with the formula $XY_3Z_6B_3Si_6O_{27}(OH,F)_4$, each of the separate X, Y, and Z structural sites is shared in varying ratio by two to four or more elements. No specimen of this common mineral has been found in which each site, or any site, is wholly occupied by only one kind of element. Similar complexities occur in many other common minerals. The complexity and variability of the composition of such minerals do not permit a convenient designation in a rational chemical nomenclature. There is no escape. The actual composition must be dealt with, since only this tells us what we have and preserves the genetic information that is carried.

This brings us to the Howe and Povarennykh proposals. In Howe's system, the names utilize arbitrary syllables, consonants, and vowels to indicate the chemical components, the stoichiometry, and the state of oxidation. Thus the mineral braunite, then formulated $Mn^{2}_{4}Mn^{4} + Mn^{4}_{2}SiO_{12}$ was renamed shamnoemniute, in which sha $= 1Si$, mnoe $= 4Mn^{2}$, mniu $= 3Mn^{4}$. and te is a formal ending. In Povarennykh's system, as in that of Thomas Thomson in 1802, the names are acronyms based for the most part on the chemical constituents. Short designations are devised for the cations, and the anionic constituents are indicated by suffixes that state the element and are terminated by ite. Structural information, chiefly symbols or abbreviations indicating that the structure involves infinite linkages in one, two, or three dimensions, is also included. For example, the layer structure $CaBi_2(CO_3)_2O$, beyerite, becomes calcbistsitophyllite. A mineral containing Na, Mn, Zr, Ti, Si, O, and F becomes namanzirtiofdisilite. Stoichiometry is indicated by names, as tricuarsulite for Cu_3AsS_4 (enargite) and ar2plum2bis4sulite for $Ag_2Pb_2Bi_4S_9$ (benjaminite); valency is reflected in the name stibstibioxite for $Sb^3Sb^5O_4$. The designations for the cations sometimes conflict. Silver is designated ar, from argentum, and arsenic is ars, causing confusion between arsulite (AsS) and diarsulite (Ag_2S). Tongue and eye twisters such as dimagalsilditilite abound. Rationality easily runs aground on the shoals of practicality!

Aside from questions of euphony. and the change in name required by changing knowledge of the chemical composition—a more serious matter than correcting the formula of a mineral known by a fixed name—mnemonic systems suffer in that one must remember both the name itself and the system of notation as well. They also compound existing difficulties of construction and pronunciation in different languages. Many of these difficulties doubtless could be reduced by adoption of an international mineralogical Esperanto. This could quickly lead to