At the least, Graham has clearly shown that there is no simple or one-to-one relationship between the tenets of dialectical materialism and what may be investigated or accepted in any given scientific field, if only because of the ingenuity and adaptability of those who do the defining as to what is philosophically acceptable. Paradoxically, Graham's own efforts to take seriously the philosophical dimensions of these various issues seem to lead to the conclusion that the real determining influences must be sought elsewhere—in the logic of science itself, in economics, or in the power struggles of individuals and institutions. This is a problem, however, which Graham does not confront directly in this book.

Graham presents complex issues of both science and philosophy with an admirable lucidity, which makes them accessible to readers with little background in the specifics of science, philosophy, or the Soviet context. Graham's solid grounding in the general history of science also provides a perspective that is often lacking in treatments of this sort of question in Soviet studies. In short, this is an important book, one which opens up new ground and should set a new standard of serious discussion in the areas with which it deals.

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The Population Biology of Man

The Structure of Human Populations. G. A. HARRISON and A. J. BOYCE, Eds. Oxford University Press, New York, 1972. xvi, 448 pp., illus. Cloth, $24; paper, $10.25.

Population can mean one thing to a social scientist and another thing to a biologist. This volume, which arose from a Wenner-Gren Foundation conference at Burg Wartenstein, brings together representatives of genetics, demography, ecology, psychology, anthropology, and sociology in an attempt to break down barriers of thought and build an integrated approach to this complex topic. And, insofar as 20 separate contributions permit, it succeeds. Appropriately, the authors include 12 Americans, 7 Englishmen, 1 Australian, and 1 Brazilian. Populations analyzed range from the Andes and the Arctic to the tropics of Africa and Asia.

The first half of the book deals more with general principles than with particular peoples. In relating the role of geographical influences in the distribution and growth of human populations, Clarke stresses the increasing importance of cultural relative to physical factors. DeJong introduces us to raw data on births and deaths and estimated fertility ratios for countries of the world in differing stages of the so-called demographic transition; his somewhat surprising conclusion is that the main determinant of aging in a population is the fertility rate. The sources, methods, and substance of the historical demographer, especially exemplified by his own studies in Norway, are treated by Drake, who maintains that the demographic experience of the preindustrial West, though far from homogeneous, is strikingly different from that of non-Western societies in that in the former households are smaller and there are tighter controls on fertility and nuptiality.

"Social regulation of fertility," by Benedict, appeals to me by virtue of its clear interrelation of cultural and biological parameters. Thus, age at marriage, polygamy, celibacy, and other patterns of social structure are considered alongside contraception, abortion, and infanticide. Benedict cites the unfortunate experience of Mauritius, where disregard of the culture led to the demise of a well-intentioned birth control program. Provocative is his statement "Except under the harshest ecological and economic conditions, human beings do not regulate their populations in relation to the food supply, but in relation to the prestige supply."

The profound effect of differential sex ratios is explored by Teitelbaum. Although a long list of factors associated with the proportion of male to female births have been suggested, Teitelbaum believes that only birth order, race, and socioeconomic status are significant. This still leaves open the question of how these factors operate. In a review of mathematical models, Hiorns suggests that formal theory plus computers will keep pace with investigations of models of demographic phenomena. The two editors of the volume relate migration to the genetic structure of populations, citing the recent theoretical work of Cavalli-Sforza and Malécot and their own studies of marriage distance (that is, the distance between the birthplaces of spouses) in Oxfordshire.

At least two papers draw on the findings of Schull and Neel on inbreeding in Japan. Schull first traces the history of the genetic effects of mating systems and then cites the small but pervasive influence of inbreeding on several physical and mental attributes in the Japanese data. Spuhler expands this theme and finds, on the basis of a wide variety of studies, significant positive assortative mating for intelligence.

The relationship of intelligence and social mobility in societies with classes or castes, explored by Halsey, makes interesting reading. In a model with simplifying assumptions of some hereditary component of intelligence, higher intellect in an upper social class that constitutes 10 percent of a population, and both upward and downward mobility between the classes, he suggests that low intelligence could be bred out of the high class but that high intelligence would never be bred out of the low class. Surprisingly, draining off of high intelligence scarcely affects the innate intelligence of the larger lower class. The assumption of a single gene for intelligence, however, weakens the conclusions. Halsey indicts the British educational system (could the American be included, too?) as "extremely inefficient . . . in turning natural ability into educational achievement."

Dobzhansky examines the question of continuing natural selection in mankind and concludes on grounds admittedly more theoretical than concrete that biological evolution has not ceased just because cultural evolution has become effective.

Subsequent chapters deal with particular populations. Thus, Salzano summarizes age and sex distribution, admixture, inbreeding, fertility, and mortality among American Indians.

One of the most thorough and interesting papers is Chagnon's explanation of social organization and its genetic consequences among the Yąnomamö. These 10 to 15 thousand Indians occupying 125 scattered villages in southern Venezuela and northern Brazil practice a bilateral cross-cousin marriage, polygyny, village fissioning, and what must surely be the most intense and continuous warfare of any people on earth; about one-third of all adult males suffer violent death. The fissioning and migration which create new villages depend upon complex kinship lines as well as upon population size. This, plus the advantages which a headman enjoys in his choice of multiple mates, leads to genetic microdifferentiation, which is well documented by findings on comparative gene frequencies.

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