The Taste for Speculation

Philip Morrison

Iosef Shklovskii earned his worldwide reputation by his marvelous pioneer explanation of the synchrotron light in the Crab Nebula. He remains the imaginative and unorthodox leader of astronomical thought in the Soviet Union. It goes without saying that such a man would turn his talents to an account of the speculative search for intelligent life somewhere outside our earth. That Shklovskii did, in a semipopular book which appeared in Moscow in 1963 under the title *Universe, Life, Mind.* Carl Sagan, a young American planetary expert, surely one of the few American astronomers whose careers include a faculty appointment at a medical school, was struck by the book and undertook to supervise it in translation (the translator is Paula Fern). Shklovskii was pleased; "the prey runs to the hunter," he wrote. **Intelligent Life in the Universe** (Holden-Day, San Francisco, 493 pp., illus. $8.95) is the result. The book has almost a third more material than the original Russian version; this is new matter, added both by Shklovskii and by Sagan. The book is a curious sort of dialogue; the co-authors have never met, and the text is woven out of two fibers. Sagan has the last word—a temptation he is not the man to resist—and to compensate, he marks his material with deltas fore and aft. A clear set of line drawings and some splendid photos through both telescope and microscope complete the book.

The content is a lively version of the rather canonical subject matter of this new subscience. (As reviewer, I know that I do not come into the court of review with clean hands, for I too have devoted many pages to speculation on this fascinating problem. Accepting that, I can say that here is a body of literature whose ratio of results/papers is lower than any other. I am not so much against more papers, especially works with the individuality and verve of Shklovskii and Sagan's book, but I certainly hope the numerator of that ratio will begin to grow somehow!) We read of the galaxies and their stellar content, the birth and life of stars, star spin, and possible planets. Then to life: a definition, in the mode of information theory, *à la russe*, with extras on the DNA story inserted by Sagan. Now the roll of the sun's planets, Mars in particular, is called up for description. Finally, the problem of intelligence outside our solar system. To begin, one needs the Copernican assumption: we are not exceptional—called here the assumption of mediocrity. Then the radio and optical-signaling problem is discussed, the anti-cryptography of such messages explained, the formal relations between distance and societal lifetime in the communicative mode produced and justified. These calculations are rewarding for the nonmathematical, challenges to clear thought but not at all technical. Their truth is another issue entirely! Three or four quite novel points remain. First, there is the notorious problem of the moons of Mars. Some data exist on the decrease of the "month" of the inner moon which imply a brief life and a large apparent drag. Shklovskii shows that a number of plausible causes are inadequate and opts for the implausible notion that the moons are artificial satellites a few miles across, hollow to hold large payloads, launched by some once-powerful Martian ministry of a dynasty long since dead. Asteroid capture and loss are not discussed, though at least the difficulty of the original measurements is clearly brought out.

Second, Sagan tells of the culture contact between LaPerouse and the Tlingit of British Columbia in 1786, an event reported a century later out of the oral tradition of the Tlingit. The ships had become immense black birds with white wings, but their crews were plainly men! Then Sagan, imaginatively but not recklessly, describes the wonderful tales of Sumer, the dawn of civilization on earth, seeking some sign of "their" visit in the legend of Oannes, who was the fishy Prometheus of Sumer. Verdict: entertaining, and very far from proved. Third, we learn of Professor Kardashev, who rejects mediocrity and thinks of societies so much more puissant than our sort that they control, not mere planetary energies, but stellar and even galactic ones. The Dyson star, with all its visible light trapped by the teeming inhabitants of a complete circumstellar shell of space ships, would be a Class Two member. This was somewhat foreseen by the remarkable Tsiolkovskii in 1895. CTA 102, a modulated quasar, perhaps, is a Class Three civilization. These notions seem rather overheated, even to an enthusiast. Marking a star with an injection of a hundred thousand tons of technetium to embellish its spectrum with an unfamiliar line is a less dubious pyrotechnical proposal than CTA 102 signals, but only just. If there are any 21-centimeter transmitters in the Andromeda Nebula with high-gain antennas and the radiated power of a star, Kardashev believes he will hear them. But it takes a Type III station to send over metagalactic distances.

So the book ends, personal, lighthearted, compendious, and worth reading.

Still one more tally for that great growing denominator has just been published. This book is by two able authors out of a very different milieu: It is **Intelligence in the Universe**, by Roger A. McGowan and Frederick I. Ordway III (Prentice-Hall, Englewood Cliffs, N.J. 416 pp., illus. $13.50). These authors are from Huntsville, Alabama, and represent the documentational and computational tradition of that large development center. Much the same outline and subject matter are found here as in the Shklovskii-Sagan book. There is a large and novel section of four or five chapters which sets forth the whole rationale of artificial intelligence, seen as a means of automating the interminable space voyages of galactic dimensions. Whole planetary computers, with or without their attendant living creators, now more parasitic than symbiotic, migrate about towards other stars and other galactic regions for more food or fuel!

The main difference, and it is great, between these two books is in style. In the first book the scientist speaks, maybe a little tongue-in-cheek now and again, rather lightly if sharply engaged with a question whose depth is perceived but

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remains inexplicit. The second, much more serious, filled with logical structure and categories and definitions, underlines all the issues with heavy crayon. Both books have plenty of epigraphic quotations: the first runs to the Book of Job, Jean Giraudoux, Pasternak, and the *Gita*; the second, to Longfellow, John Haynes Holmes, Teilhard de Chardin, and Shelley. The first is illustrated with photos and line diagrams alone; the second has as well a set of air-brush paintings of remote fantastic planetary surfaces complete with strange ships and fierce beams. In the first book, we learn that the machined steel block kept in the Salzburg Museum as an artifact of the Carboniferous era is a fake. In the second, it is "Dr. Curlt's Cube" and described with quotes. Ordway and MacGowan are not credulous; they don't believe it either, but they don't say so because they have no clear basis in citation. The second book is somehow both indulgent and official. It quotes the Air Force at length, quite interestingly, upon saucers. It is tight in outline and structure, but wordy in text. It is rather diffident in comment, especially on the general foolishness of the Russian answer to the UFO, the Great Tunguska Meteor, seen by some over there as a space-ship crash. It comes out of a world of military intelligence, of big film studios, of Air Force translations, of astronautics, of position papers, library searches, programs and planning. If it suits your taste, it will be an equally useful source of the canon of speculation in this strange field.

No question exists in my mind that these books presage a future science. It isn't here yet. With last year's popular success *We Are Not Alone*, I hope the market will feel replete. Certainly there is a choice for readers of many tastes, romantic, cinematic, or journalistic. The science is yet to be born, but the literary genre is already mature. The books reflect our world, not "theirs." Will the critics remain far behind?

Function and Structure in Physiological Psychology

The science of psychology may be classified in a variety of ways, for instance as social, behavioral, biological, mental, philosophical, or even humanistic (*1*). All but the biological approach, Joseph Altman insists, segregate psychology from its proper status as one of the life sciences. He strives to integrate psychology and biology in **Organic Foundations of Animal Behavior** (Holt, Rinehart, and Winston, New York, 1966. 544 pp., illus. $12.95).

To read the book is to marvel at the prerequisite Altman sets for himself and his peers. He states (p. 19):

> It is not our task to deal here in detail with the great wealth of biophysical, biochemical, and biological studies that are relevant to an understanding of organic structure and function, though familiarity with these findings is an absolute prerequisite to an understanding of the organic foundations of behavior.

Those familiar with the Darwinian influence in American psychology and with the systematizing tradition laid down by William James (*2*) in his *Principles of Psychology* will not find Altman's approach novel. Indeed, there are several striking parallels between the 1890 approach of James and the 1966 approach of Altman. Some of the more fundamental of these parallels will be considered later in this review. First, let us examine what Altman has accomplished in "over a decade" (p. ix) of self-education, writing, and rewriting.

Organisms, according to Altman, are complex, self-regulating, material systems. They are divisible into constituent elements on the one hand and organized subsystems on the other. In addition, they possess organizing properties not found in physical matter. The study of the organic foundations of behavior, Altman goes on to say, must be analytical (reductive to constituent elements and mechanisms), correlative (comparative within a particular level of organization), and teleological (functional within and between hierarchic levels of organization). Structures, processes, mechanisms, and functions of living matter are then described, beginning with the atomic elements found in organisms and including, in turn, inorganic and organic molecules; vegetative processes and animative activities; the senses, motor apparatus, neurons, glia, and neuronal organization; control by spinomedullary, paleocephalic, and neencephalic systems; organismic programming of transactions with the external environment; and, finally, four functional systems of behavior, self-preservative, species-preservative, group-forming and maintaining, and external-environment-mastering.

There is, however, unevenness in the treatment of particular topics. Altman is clearly on his home range when he discusses the structure of sensory apparatus and the structure of the nervous system. Insofar as he treats behavior in the context of such structural discussions, the text moves along in lively and comprehensive fashion. Perhaps the major omission is the lack of reference to Dethier's research (*3*) on motivation in the blowfly. By remarkably painstaking techniques, Dethier is rapidly closing in on both the internal factors and the external stimulus properties controlling the ingestive behavior of the blowfly. In view of Altman's biological orientation, the omission of such important work by an experimental zoologist and psychologist must be counted a fault. On the positive side, consideration is given in the book to the findings of E. Stellar, P. Teitelbaum, and A. N. Epstein, fellow faculty members of Dethier's at the University of Pennsylvania.

In contrast to his discussions of structures, Altman's teleological statements are jarring, despite the analogy of negative feedback. At best such statements call attention to problems requiring quantitative study. Presumably the thoroughgoing biological functionalist will approve of the teleology, and the thoroughgoing biological mechanist will dismiss it.

Although Altman does an acceptable job on motivation and learning in the context of organic structure, his treatment of learning as a subject matter in its own right (pp. 343–57) is technically erroneous and disappointing. Extinction, for example, is equated with inhibition (p. 350). Pavlov himself wrote (*4*, p. 49):

> This phenomenon of a rapid and more or less smoothly progressive weakening of the reflex to a conditioned stimulus which is repeated a number of times without reinforcement may appropriately be termed *extinction of conditioned reflexes*. Such a term has the advantage that it does not imply any hypothesis as to the exact mechanism by which the phenomenon is brought about.

To equate extinction with inhibition, as Altman does, misses the whole point of Pavlov's contribution to the measurement of behavior.

Even more erroneous is Altman's misreading of B. F. Skinner (*5*). Skinner's singular contribution to the measurement of learning and behavior, rate