Iosif Samuilovich Shklovskiĭ (Obituary)

E. P. Aksenov, V. F. Esipov, N. S. Kardashëv, V. G. Kurt, T. A. Lozinskaya, V. I. Moroz, I. L. Rozental', R. Z. Sagdeev, P. V. Shcheglov, V. I. Slysh, and Ya. B. Zel'dovich

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Soviet science has borne a grievous and irreparable loss with the death on March 3, 1985, of the eminent Soviet astrophysicist, corresponding member of the Academy of Science of the USSR, and Lenin Prize laureate Iosif Samuilovich Shklovskiĭ, Developments in many new areas of astronomy and space research in our country were closely associated with his name.

Shklovskiĭ was born at Glukhov in the northern Ukraine on July 1, 1916. By 1938 he had graduated from the Moscow State University physics faculty and had entered the affiliated Shternberg Astronomical Institute as a graduate student. Due to poor eyesight he was not required to do military service during the war, and when his graduate studies ended he remained at the Shternberg, with which he was connected until his last days. He defended his candidate's dissertation in 1944.

It was the practice of Iosif Samuilovich to settle on nonclassical research problems of exceptional difficulty, and luckily for him twentieth-century astronomy spawned one such problem after another. For instance, in the early forties the spectral lines emitted by the solar corona were discovered to represent forbidden transitions in multiply ionized atoms, such as Fe XIV and Ni XV. Shklovskiĭ's first series of papers dealt with the theory of coronal ionization. Then it was found that the sun is a powerful source of radio waves, and sure enough, Shklovskiĭ promptly responded with his pioneering 1946 study in which he showed that solar radio emission consists of two components entirely different in origin: thermal and sporadic. By analyzing the very limited data available at that time he succeeded, with deep physical intuition, in singling out plasma oscillations as the mechanism generating the sporadic component. Theories of the solar corona's ionization and radio waves not only were the subject of Shklovskiĭ's doctoral dissertation, accepted in 1949, but were treated in his 1951 monograph *The Solar Corona* (revised in 1962 and published in English in 1965).

As the decade of the fifties opened, Shklovskiĭ's scientific interests shifted to galactic radio astronomy. He calculated what the intensity of interstellar hydrogen emission in the 21-cm radio line should be, and he demonstrated, in 1949, that 21-cm line measurements could offer a powerful new tool for exploring the Galaxy. Soon afterward such observations were initiated and forthwith became the standard procedure. It was not until much later that another of Shklovskiĭ's proposals, no less fruitful, was a reality: observing the radio lines of interstellar molecules.

During this same period Shklovskiĭ did some valuable work in planetary cosmogony, showing in 1951 that giant planets could not be converted into earthlike planets simply by thermal dissipation of light gases, contrary to certain naïve views held at that time. He was also occupied with geophysics: when some strong upper-atmospheric emission features were discovered in the near infrared, Shklovskiĭ identified them, in 1951, with OH emission bands.

I. S. SHKLOVSKIĬ, 1916–1985.

In 1951–1952 Shklovskiĭ became the first in our country to give a course on radio astronomy. A brilliant lecturer, he spoke before not only students but many of the staff from astronomical institutions around Moscow. This new course laid the groundwork for his second monograph, *Cosmic Radio Waves* (1956; English edition 1960). To his astrophysics students in those years he also gave a full-scale course in theoretical physics. For some three decades he held the rank of Professor at Moscow University.

Shklovskiĭ was named head of the radio astronomy department at the Shternberg in 1953. Radio astronomy was

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indeed his main enthusiam, but from the very outset he strove to broaden the scope of the new department. He enjoyed working with young people: he would seek out gifted students and foster them, generally choosing the ones who wanted to do experiments and observations using new techniques. Sweeping vistas opened up, and yesterday's students practically one after another would take on themselves whole branches of science, like ultraviolet and infrared astronomy, or electronic aids to the telescope. They acquired under Shklovskiĭ's tutelage the trait of scientific daring—the broad approach. Right from the start the Shternberg radio astronomy department actually constituted a center for the new astrophysics. Toward his colleagues, Shklovskiĭ's attitude was profoundly unselfish. Practically none of the papers by this students bear his name as coauthor; yet of those whom he trained, two have gone on to become corresponding members of the Academy; ten have doctorates and about thirty hold the candidate's degree.

During the fifties and sixties Shklovskiĭ published important material in galactic radio astronomy. Laying the foundation for the physics of supernova remnants, he recognized the synchrotron nature of the "amorphous" component in the Crab Nebula's optical structure (1953): this single physical mechanism could account for the entire spectrum of the Crab from the optical range to meter radio waves. He predicted in 1960 and devised a theory for the secular decline in the radio flux from the expanding relativistic-particle clouds which we observe as supernova remnants. This effect was soon confirmed by experiment. In 1956 Shklovskiĭ published two groundbreaking studies of planetary nebulae, showing that their central stars represent a stage in the evolution of red giants, and are themselves destined soon to metamorphose into white dwarfs. He also developed a new method for measuring the distances of planetaries.

Shklovskiĭ invoked the synchrotron mechanism to interpret the radiation from the jet protruding from the galaxy M87, and in 1954 he predicted that the light from it would be polarized. He was the first to assess correctly the total energy of the relativistic particles and magnetic fields in radio galaxies (1953–1956), and in 1965 he applied the concept of expanding relativistic-particle clouds to the radio emission of quasars.

It was in 1966 that Shklovskiĭ was elected corresponding member of the Academy. But the bounds of the Shternberg Institute proved too confining for the youthful, burgeoning group in his charge, and in 1968 he organized and headed up a new astrophysics department at the Academy's Institute for Space Research, Moscow, to which some of his students transferred. At the same time he continued to guide the Shternberg department on public matters. From the days of the earliest artificial satellites Shklovskiĭ was intimately involved in space research: he helped interpret the experiments on the first rockets to the moon and he proposed the entrancing idea of an artificial comet. The scientific work which Shklovskiĭ's followers had carried on under his general direction at the two Institutes covers the whole gamut from γ-ray to radio astronomy and nearly every class of astrophysical object from the planets to the cosmic background radiation. Both ground-based and space instrumentation has been pressed into service.

In his final years Shklovskiĭ remained an active theorist. Cases in point include his papers on the double nucleus of the radio galaxy Perseus A (1978) and the evolution of quasars (1982). Meanwhile he devoted much energy to the popularizing of science, writing several semipopular books that have attracted a wide readership and have repeatedly been reprinted and translated.

Over his lifetime Shklovskiĭ published seven books and monographs, and some 200 scientific papers. He gained due recognition among the world's astronomers as one of the shining leaders of our nation's astrophysics. In 1964 he was named a foreign Associate of the Royal Astronomical Society, London, and was honored as well by the American Academy of Arts and Sciences (1966), the National Academy of Sciences in Washington (1972), the American Astronomical Society, and the Royal Astronomical Society of Canada. And in 1972 he was awarded the Bruce Gold Medal of the Astronomical Society of the Pacific.

Truly exceptional was the charm of Iosif Samuilovich's personality. Yes, he could err, but he always remained sincere. His penetrating analytic mind, his inexhaustible humor, his brisk amiability—those were his specially appealing features. The memory of I. S. Shklovskiĭ, a man of science in capital letters, will glow in our hearts forever.

Translated by R. B. Rodman