But at least at that time it had no other meaning but vice-president, and these gentlemen might have been no less startled at being called "comrades" than Shetler, who in pre-Soviet Russia could have been a *tovarishch kuratora,* might be today if someone should address him as "comrade curator." The author also calls the Komarov, with no qualification, the leading Russian botanical institution in both the past and the present. However, this is true only if plant physiology is not considered part of botany. The leading Russian institution in that science is, and has been since its inception, the present Timiryazev Institute of Plant Physiology in Moscow, like the Komarov an institute of the Academy of Sciences of the U.S.S.R.

On a few occasions one may feel that the author's objectivity is carried too far. It might have been worthwhile to explain why the fortunes of the Russian Botanical Society reached such a low point as they did in 1932, since this is an interesting illustration of the situation of science in a totalitarian system. It may have been no less interesting to know that the Komarov Institute and its leaders had enough courage to offer a haven—perhaps a modest one—to at least one of the few Russian biologists who refused to bow to Lysenko even after 1948, when Lysenko was all-powerful, his doctrines having been endorsed by Stalin himself.

But although perhaps interesting these are points of relatively small significance. The rather complicated history of the present Komarov Institute—what was founded on Saint Petersburg's Pharmaceutical Island 250 years ago was really quite different from what is standing in the same place in Leningrad today—is described concisely, accurately, and with a sympathy which is attractive and entirely legitimate. The contributions of the institute and its predecessors in descriptive botany, which are indeed outstanding, are discussed clearly and with profound understanding. And since in this area of botany the institute has indeed always maintained the leading position in Russia, Shetler's book mirrors the history of much of Russian botany as a whole.

Furthermore, if read carefully it mirrors a good deal more, namely, certain features that seem quite typical of Soviet Russian biological sciences in general. There is a predilection for organizational matters. The structure of the Komarov Institute, with its departments, laboratories, and secondary laboratories or "groups," may well be the most complex one of any botanical institution on the globe, and moreover does not strike one as perfectly logical; for example, there is no department or laboratory of plant physiology, but there are independent laboratories of photosynthesis and of microelements, while the Laboratory of Physiology of Growth and Development is, rather surprisingly, part of the Department "Botanic Garden." Fortunately, it seems that these rather artificial boundaries are no serious obstacles to the scientific work and that they can be torn down (and replaced by others) with no or very little advance notice. Another and more serious feature of Russian biology which is also reflected in Shetler's account is the love—or is it an outcome of the methods of training?—of eminent Russian biologists for sweeping theories (the Russians themselves like to call them *ucheniya,* teachings, probably oblivious of the religious implications of the word), which are often followed and defended with little regard for new facts, whether coming from new observations or from new technical advances. Komarov was undoubtedly an outstanding systematist, and the 30-volume *Flora of the U.S.S.R.,* which is his accomplishment even though his direct contributions were quite small, is, as Shetler rightly says, an epitome of everything that is good about programmed research; it is the most outstanding contribution of Russian botany, and is, one may add, outstanding by any standards. But Komarov was an extreme "splitter" and moreover rather dogmatic in this attitude, and it is today clear that, to say the least, his concepts cannot be applied to any and all taxonomic groups. The *Flora,* however, has followed these concepts rather faithfully, and the resulting ambiguity of what it calls a "species" is the one fundamental weakness of which it can and must be accused. Even now, after the *Flora* has been completed, and although Komarov left the institute 30 years ago and has been dead for almost 25 years, his "teachings" seem to influence, one way or another, much of the work in the institute that bears his name; one cannot help the feeling that they are becoming more of a liability than an asset, standing in the way of the development and even the adoption of newer, promising methods in systematic research which are already widely accepted elsewhere.

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High-Powered Observation

Radar Astronomy. JOHN V. EVANS and TOR HAGFORS, Eds. McGraw-Hill, New York, 1968. xx + 620 pp., illus. $19.50.

Although radar astronomers are rather few in number, an interesting claim is made on their behalf that some of the most important recent advances in radar in general, notably in signal processing, have come from radar astronomy. If one thinks of radar astronomy as a field of basic research aimed at exploration of our environment, it is interesting to recall that the original development of radar for civil and military purposes stemmed from earlier endeavors in the scientific exploration of our physical environment. In fact, two basic kinds of radar, the frequency-swept continuous-wave radar and the pulsed radar, were both introduced in the same year (1925) by Appleton and Barnett in England and by Breit and Tuve in the United States with their successful demonstrations of the presence of the ionosphere. Evidence for the existence of an electrically conducting layer had been clearly developed by Heaviside and Kennelly from observations of radio propagation, and by Balfour Stewart from observations of the terrestrial magnetic field, but not everyone believed it; whereas the introduction of the radar technique immediately revealed the presence of two layers and gave their heights.

Application of radar to the exploration of the solar system has been just as impressive. Astronomical accuracy is famous, and in the hands of radio astronomers is becoming even more astounding. The accuracy with which the astronomical unit is known has been improved by three orders of magnitude by measuring the range to Venus, and is now limited by knowledge of the speed of light, the elements of the planetary orbits, and the radii of the planets. Further work in the field of echo delays will thus lead to improvement of planetary data.

Surprises were in store over the planets Mercury and Venus as regards their rotation rates, which can be studied from Doppler broadening of the echo and by a special "delay-Doppler" technique that makes use of returns from discrete surface features. Mercury had been thought, from visual observations of surface markings extending over many years, to have a rotation period of 88 days, which is the same as its orbital period. It now turns out that Mercury makes three rotations in two orbital periods. Such an integral relationship was not known for any other planet, and it clearly plays an important role in understanding how the planets came to have the motions they possess today. Venus, being concealed by cloud, did not have an official rotation period. It now seems that it rotates backward and in the Sun-Earth frame it appears to make four backward rotations in one synodic period. (The synodic period, or time between inferior conjunctions, is 584 days, the sidereal period is 225 days, and the rotation period 243 days approximately.)

These almost unbelievable discoveries, especially the synchronization of Venus with the Earth, emphasize that we do not know how the solar system evolved, but they furnish new handholds. We may look forward to rich data of the same kind when the numerous satellites of Jupiter and Saturn come within radar range.

When another 40 decibels over and above that necessary to work with Jupiter can be brought to bear, then it is expected that Saturn, Uranus, Ganymede, Callisto, Io, and Europa can be studied; but as of the date of writing, Jupiter remains a marginal target. An improvement of 40 decibels results from an increase of a factor of 10 in antenna diameter; so if $10 million is the cost of the largest radar astronomy antennas, it appears that the hoped-for data would come at a cost of perhaps $1 billion. At such a price it may be that the radar astronomy of the outer planets and their satellites will be done by small radars on space probes sent to the outer planets, some years from now.

Radar Astronomy, which is the only substantial book in its field, contains basic chapters on scattering by targets, radio propagation through the atmosphere and ionosphere, radar systems, antennas, transmitters and receivers, and data processing, all written by well-known experts, and, in addition to the planetary studies referred to above, has major chapters dealing with the Moon and the Sun.

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Theoretical Study of Plasma Phenomena

Electromagnetic Fluctuations in Plasma. A. G. SITENKO. Translated from the Russian edition (Kharkov, 1965) by Morris D. Friedman. Academic Press, New York, 1967. xiv + 256 pp., illus. $12.50.

This book deals with the theory of fluctuations of electron density, electric field intensity, and other related quantities in plasmas. It contains a collection of specific results, for correlation functions and power spectra, in a large number of special cases. These results should be very useful to persons whose research involves fluctuations in plasmas, among them those who are investigating noise measurements, deflection of charged-particle beams, or electromagnetic-wave scattering by fully ionized plasmas.

The results of the theory are derived by the author in a rather formal way, so that the reader who desires a clear exposition of the fundamental principles of the subject, based on physical ideas, must look elsewhere. It's a shame that the author does not present the test-particle method of Rostoker, which is an important contribution to the subject.

The basis of the method which the author uses to obtain most of his results is the fluctuation-dissipation theorem. The derivation of this theorem, from the general principles of quantum mechanics, is given in chapter 1. Since the theorem applies only when the distribution functions are Maxwellian, the results obtained are not very general. Also, the author has considered only plasmas that are spatially homogeneous, which will make the book somewhat less useful for experimentalists than for theorists.

With these limitations, the author does discuss the results of the theory of electromagnetic fluctuations for many interesting cases. He considers both electron plasmas and electron-ion plasmas, including cases where the electrons and ions have different temperatures, both with and without an external magnetic field. He emphasizes the types of waves which can propagate in such plasmas. The power spectra for some of these cases are used in calculations of the dynamical friction and diffusion coefficients, and of the electromagnetic-wave scattering coefficients in a plasma. These subjects are treated in considerable detail, and this is one of the attractive features of the book. The author also discusses quantum plasmas, degenerate electron gases, and superconducting plasmas, although the treatment of these subjects is rather sketchy.

The general approach used by the author, the formal deduction of results from the general fluctuation-dissipation theorem, gives one very little physical insight into the dynamics of plasma behavior, that is, "what the particles are doing." However, the abundance of detail, the many interesting cases considered, and the 27 illustrative figures should make the book a useful reference for specialists.

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Optical Properties

Dynamical Processes in Solid State Optics. Summer Lectures in Theoretical Physics, Tokyo, 1966, Part 1. RYOGO KUBO and HIROSHI KAMIMURA, Eds. Syokabō, Tokyo; Benjamin, New York, 1967. viii + 245 pp., illus. $7.50.

This is a collection of ten excellent, but unfortunately not reasonably related, articles. Even the writer of the dust-jacket blurb for this small volume recognized three topics: macroscopic optical properties of dielectrics, structures in the spectra of solids, and laser physics. But it is not in the choice of subject matter alone that the content is heterogeneous: there are both review papers and research papers. Furthermore, the former range from the general (Burstein on dielectric media) to the very recent (Phillips on work in optical spectra of solids reported since the completion of his last review article in 1965); the latter, from comparatively recondite and specific contributions (Hopfield on elastic scattering at inelastic thresholds) to what is essentially a new chapter in a long series of papers by one author (M. Lax) on classical and quantum noise.

Much has been written lately on the so-called "information explosion" and the obsolescence of scientific journals it allegedly entails [see, for example, W. S. Brown, J. R. Pierce, and J. F. Traub, *Science* **158**, 1153 (1967)]. Organized distribution of unrefereed "preprints" is one consequence of this dissatisfaction with journals; the ever more frequent publication of the proceedings of conferences, symposia, summer schools, and the like is another. This latter practice serves a valid purpose when the meeting is a coherent one, either scientifically or pedagogically; it does not when many unrelated subjects are touched on from many different view-