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Personalia

VLADIMIR PAVLOVICH LINNIK

(On the occasion of his seventy-fifth birthday and the completion of fifty years of scientific work)

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NOWADAYS, the application of optics and the use of optical instruments in science are of the greatest importance. Vladimir Pavlovich Linnik is the foremost optical physicist in the USSR. The principal matters with which he has been concerned throughout his activity are the optics of x rays, optical methods of investigating crystal structure, interference microscopy, optical testing of precision in machine parts, telescopes with interference equipment and the use of interference in astronomy in general.

On July 6, 1964, Linnik celebrated his seventy-fifth birthday and almost half a century of scientific and pedagogical activity. He was born in Khar'kov on July 6, 1889. In 1909 he was graduated from the secondary school in Belaya Tserkov' with a gold medal and entered Kiev University.

After majoring in physics and mathematics, Linnik graduated from the University cum laude in 1914 and was engaged as an instructor. He then worked in a number of other institutions. In 1926 he was taken on by the then new and young and today famous scientific establishment, the State Optical Institute. Simultaneously, from 1933 to 1941 Linnik also taught at the Leningrad State University with the rank of professor, while since 1946 he has also been working in the "astronomical capital of the world"—the Main (Pulkovo) Astronomic Observatory of the Academy of Sciences of the USSR (latterly in the division of astrophysics and the astrophysical laboratory).

In 1939 Linnik was elected full member of the Academy of Sciences of the USSR, while in 1946 and 1950 he was awarded the State laureate prize.

For his scientific and technical achievements, the USSR Government gave Linnik the Order of Lenin, the Order of the Red Banner, and other honorary awards.

In addition to his fruitful scientific work, Linnik is very active in public affairs, and, inter alia, serves as deputy of the Leningrad City Soviet of Working People's Deputies.

A number of investigations carried out by Linnik have become classics. These include: a method of high-precision determination of the index of refraction for x-rays from the characteristics of total internal reflection (1926 and later), a method of investigating the structure of crystals (1929 and later) through x-ray diffraction, Lloyd x-ray interference (1930), special microscopes, etc.

Linnik and his collaborators have been working in close contact with plants producing optical instruments, and the result has been that the new advanced methods and apparatus evolved by them were quickly taken over by industry.

Outstanding achievements of Linnik's are a method of controlling the purity of preparation of surfaces by studying their microstructure, optical control of internal stresses (tensions), and a method of checking the assembly of microscope objectives. The first two are of particular importance today in the case of rubbing surfaces moving at great speed and of great loads on certain parts of machines and instruments.

Among apparatus designed by Linnik, the following are especially well known: (1) double microscope (1929); 2) interference microscope or microinterferometer (1933) for testing high-grade purity of preparation of surfaces with parallel distortions resulting from working; (3) microprofilometer for measurement in cases where the traces of surface finishing are complex in form; (4) the large Linnik–Mach interferometer. Some of this apparatus is very highly regarded; in particular, it carried off the Grand Prix at the Brussels World's Fair in 1958.

Of quite special interest are the astronomical methods and instruments developed by Linnik (or by a large group of his collaborators under his direction and on the basis of his ideas), some of them very recently.

As early as 1921, before the Second Congress of the Russian Association of Physicists, Linnik presented a method of investigation of parabolic mirrors and telescope objectives. He returned to the same subject in 1931 and again later.

Among the astronomical apparatus evolved by Linnik, the following particularly deserve mention: devices for examining spectrograms and measuring wave numbers, an interference transit instrument, stellar and solar interferometers, an interference angle etalon, a slitless stellar spectrograph with interference reference marks, etc.

The device for examining spectrograms (1930) greatly reduces measurement difficulties caused by the poor visibility of weak spectrum lines on the photoplate. The use of this device not only lightens the spectroscopist's task, but gives more accurate results with visual measurement. The original width of the investigated spectrum may be small, since Linnik's device enlarges it by means of oscillation.

This device greatly facilitates investigation of spectra of weak stars, whose spectral lines come out on photographs as narrow "threads." Such equipment is now being produced industrially.

It should be noted that Linnik was the first to make practical use in astronomy of the sighting possibilities of the Michelson stellar interferometer, in particular in a periscopic transit instrument. Linnik's work on astrometric optics also includes a laboratory method of measuring the curvature of telescopes of meridian instruments, which he proposed in 1950 and which has been applied by his collaborators.

At the Twelfth Astrometric Conference in 1955, Linnik presented a detailed report on the prospects of development of astrometric instruments in general. He stressed the need to elaborate differential optico-mechanical (and electronic) methods and means of angle measurement, of three types—for measuring minutes, degrees and tens of degrees respectively. Only by use of such methods will it be possible to improve appreciably the accuracy of astrometric measurements, which often is no better than 0.1 sec. (when using old meridian instruments, which are still widely employed by astronomers).

Linnik's stellar interferometer is also "periscopic," and is used for measuring small angle distances and position angles (widely spaced components of double stars, 1947), modern electronic devices being used for the recording. The first, experimental apparatus was built back in 1949 and installed in Pulkovo. This new instrument (a simplified version of which was constructed by Michelson in 1890) was based on the phenomena connected with diffraction on a double aperture diaphragm placed symmetrically in front of the objective of the reflector-telescope. As is usual, Linnik's instrument makes it possible to study the interference pattern (fringes) of two stars observed in the focal plane. The instant of vanishing of the fringes as the diaphragms (periscope mirrors) are moved apart determines the angle separation of the components of the star. To ensure smooth movement of the diaphragms (or mirrors), in Linnik's instrument the required additional path difference is achieved by means of a special optical system (allowing measurement of movements of a small light prism, which is also interferometrically controlled). Moreover, two images of the investigated pair of stars may be observed, with interference fringes on the principal star (first image) and on its companion (second image).

Linnik's stellar interferometer, which is a working model, has the advantage over Michelson's device that it allows measurement of considerably greater angle separations (from 0 to 25″) with great precision (0.01″ for visual observation and 0.002″ using a photoelectric method of unit measurement with a 6-m base); it also has a different registration method, a different principle of measurement, etc. A more powerful, largely automatic and very convenient version of the instrument has just been built industrially for installation at the Pulkovo Observatory.

A 140 mm meniscus heliometer, or solar interferometer, built in 1951 on the basis of a design made by Linnik in 1950, is another one of Linnik's new instruments. It is intended for precision differential measurement of the diameter of the sun, since the usual (photographic and visual) measurements give imprecise values, ranging from 1918.4 to 1920.2 sec. (at the mean distance of the earth from the sun). Even in the almanacs published in various countries, the diameter of the sun, a most important astronomical constant, is given accurate to 0.5″. Consequently, the construction of a precise instrument for measuring the sun's diameter was of the greatest interest. Linnik's instrument is based on the principle of using the sighting property of the periscopic interferometer. It attains a precision of 0.1″, and the use of photometric methods (since the edge of the sun is diffused by atmospheric turbulence and other causes) gives reason to believe that even greater precision may be attained by using this advanced and highly promising technique.

Another device of Linnik's—the interference angle caliper—can be widely used in astronomy, in particular to control the scale of the image in astrographs and in phototelescopes in general. It is also used in machine building, when high precision measurement of lengths is required.

One of Linnik's latest instruments, which he has built as a working model (1959), is a slitless spectrograph with interference reference marks used as the comparison spectrum. It gives a slitless expanded spectrum of the star with a contiguous comparison spectrum in the shape of a continuous spectrum of the same star cut across by Talbot interference bands, which serve as ideally non-diaphragmed reference marks in measuring the shift of lines in the spectrum.

Recently, Linnik has been applying his scientific and designing talents in physics and astronomy to the solution of a problem of great topical interest—compensating for the instability of the images of the wave front of light rays from stars caused by the turbulence of the earth's atmosphere. He has proposed a device which will ensure complete compensation (1958); its application will greatly increase the power of modern telescopes.

A feature of Linnik's most recent work is the use of electronic devices and automation in constructing various physical and astronomical apparatus. He has been successfully employing image amplifiers, electron-optical converters, cathode ray oscillographs and other electronic devices, from the simplest to the most intricate. As a rule, Linnik tests his designs by constructing working models, and only when he is satisfied with them are they commercially produced.

Linnik personally works with metal-cutting and

other machines, and with a telescope built by himself and installed in his small observatory in Komarovo, near Leningrad. Whenever he has an idea for a new instrument, he explains it in detail to the members of the large group which he heads and to his close colleagues. They study his idea with interest, help him to overcome such difficulties as may arise, and thereby assist in the practical realization of some new method or the construction of some radically different equipment.

An outstanding specialist in applied physical and astronomical optics, Linnik, like all Soviet scientists, is very attentive to his collaborators, especially young scientists. He shares with them his vast experience, is sensitive to their needs, and is quick to help them, to praise their successes and criticize their shortcomings; he thereby furthers the formation of cadres of optical physicists and astronomers and contributes to the rapid progress of Soviet science.

LINNIK'S MOST IMPORTANT WRITINGS

1. A method of investigating parabolic mirrors and telescope objectives. In the book "Proceedings of the Second Congress of the Russian Association of Physicists," Kiev, State Publications, 1921, pp. 17 and 18.

2. Die Bestimmung des Brechungsindex der Roentgenstrahlen aus der Erscheinung der Totalreflexion. Z. Physik, 1926, Bd. 38, H. 9-10, pp. 659-671.

3. Ueber die Beugung der Roentgenstrahlen an einem Zweidimensionalen Kristallgitter. Z. Physik, 1929, Bd. 55, H. 7-8, pp. 502-506.

4. Instrument for interference investigation of reflecting objects under the microscope. DAN SSSR, 1933, No. 1, pp. 18-23.

5. Instrument for interference investigation of surface microprofiles—the "microprofilometer." DAN SSSR, 1945, 47, No. 9, pp. 656 and 657.

6. The interference heliometer. In the book "Proceedings of the Tenth All-Union Astrometric Conference," 1954, pp. 229-234, Leningrad.

7. Interference astronomical instruments at the Pulkovo Observatory. In the book "Proceedings of the Eleventh Astrometric Conference of the USSR," Leningrad, 1955, pp. 172-174.

8. Possible developments of astrometry from the standpoint of instruments. In the book "Proceedings of the Twelfth Astrometric Conference of the USSR," Leningrad, 1957, pp. 179-185.

9. On the theoretical possibility of decreasing the influence of the atmosphere on the image of a star. Optika i spektroskopiya (Optics and Spectroscopy), 1957, 3, 4, pp. 401 and 402. (Also in book "Proceedings of the Conference on the Scintillation of Stars," Leningrad, 1959, pp. 228-232).

10. Slitless stellar spectrograph with guiding device and spectrum reference marks. In the book "New techniques in astronomy," Leningrad, 1963, pp. 176-179 (also in DAN SSSR, 1959, 124, No. 5, pp. 1009 and 1010).

Translated by Mrs. Valentina S. Rosen