Vladimir L'vovich Broude (Obituary)

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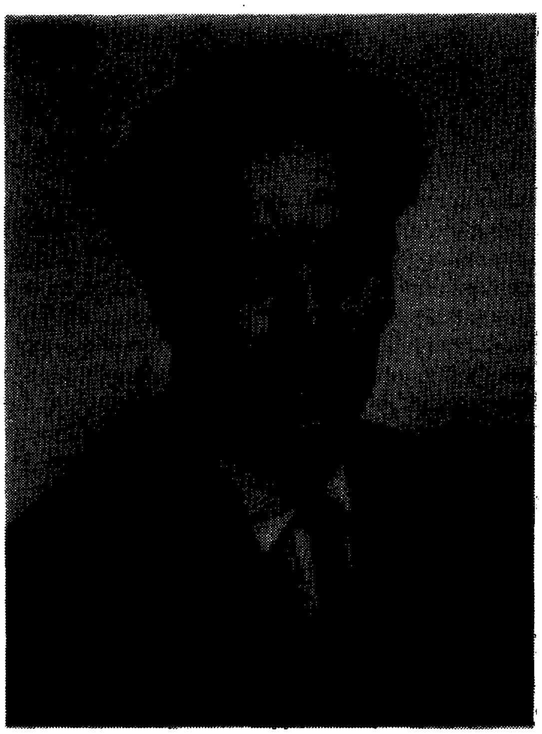
Professor Vladimir L'vovich Broude, a prominent Soviet physicist, Lenin Prize laureate, and Doctor of Physical-Mathematical Sciences, died before his time on 22 June 1978. His achievements included fundamental results in solid-state spectroscopy, with emphasis on molecular crystals.

Broude was born in Moscow on 1 December 1924. His father was a prominent biochemist, his mother a physician. He graduated from the Moscow Chemical Engineering Institute in 1947 and was sent to work as a cryogenics engineer in the Spectroscopy Division of the Ukrainian Academy of Sciences Institute of Physics at Kiev. His immediate task was to develop and finalize equipment for low-temperature spectral research. However, those of his qualities that were later to ensure him lifelong success soon became evident. He immediately broke out of the confiner of his direct engineering responsibilities, acquiring a deep interest in low-temperature spectroscopy itself; he began to study quantum mechanics, group theory, etc. The result was exceptionally fortunate: his first paper on the spectroscopy of molecular crystals—the exciton multiplet in benzene (1951)—immediately became a classic, and its success was a double one: both purely scientific and methodological. Broude was, of course, in a way lucky: he went into molecular exciton spectroscopy at precisely the time when this field was ripe for intensive development. But it was his paper on benzene that provided one of the decisive stimuli for this development. Strongly polarized "crystalline" bands had just been observed in experimental spectra, and a theory of exciton multiplets had been developed. Broude's paper on benzene contains the first experimental proof of the identity of the "crystalline" bands and exciton multiplets. The benzene paper therefore pointed the way to further broad-scale experimental study of the exciton spectra of molecular crystals. It was very significant that a microprojector invented in the course of this work was used for the first time to photograph the low-temperature spectra of small single crystals in polarized light; this study therefore simultaneously provided the methodological base for further research.



VLADIMIR L'VOVICH BROUDE (1924-1978)

The intensive work done in the years that followed, in which Broude participated very actively, resulted in rapid advances with the accumulation and analysis of extensive experimental material on the exciton spectra of specific crystals, their changes in phase transitions and under deformation, etc. These results form the foundation of our present-day conceptions of the general structure of exciton spectra.

A new range of problems gradually emerged in the course of these studies: precise and unambiguous identification of exciton spectral bands and determination of the genesis and structure of exciton-level bands. This required development of a battery of new experimental procedures. Methods based on investigation of the spectra of solid solutions were found to be most effective here. The basic facts on which they rest were discovered experimentally in the studies of Broude and his students.

For example, impurity exciton bands were discovered in the spectra of concentrated isotopic solutions (1961), with observation of several exciton multiplets according to the number of components in the mixture; this behavior, which was later observed in various disordered systems, came to be known as multimode behavior. Study of the spectra of isotopic solutions as functions of component concentration made possible direct observation of the development of the exciton multiplet from the impurity band, thereby directly establishing a gen-

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etic relation between the components of the exciton multiplet and a definite band in the spectrum of the molecule. A gigantic change in the intensity of the impurity bands, either flareup or extinction, was discovered later (1961) and made possible definite identification of exciton spectral bands, determination of boundary positions in exciton band structure, etc. It was these studies that made exciton bands in molecular crystals just as much of an "experimental reality" as the electron bands of metal and semiconductors. Study of molecular-exciton band structure in various substances became a regular procedure at that time. Broude also helped originate the dynamic approach to the vibronic (electron vibrational) spectra of crystals (1966), which has made it possible to describe both purely excitonic and vibronic spectra of pure and doped crystals on a common basis.

These studies of Broude composed much of the series of exciton-spectroscopy investigations for which a group of Soviet physicists was awarded a Lenin Prize in 1966.

Immediately after the appearance of the first lasers, Broude plunged into study of the physical processes that unfold in them with his characteristic diligence. In 1963, he organized the Quantum Electronics Division of the Ukrainian Academy of Sciences Institute of Physics, staffing it with people infected with enthusiasm for the new field. His ideas on the use of molecular crystals with their wealth of spectral transitions for tunable lasers and development of a dispersion cavity also date from about this time.

In 1966, Broude moved to a position in the USSR Academy of Sciences Institute of Solid State Physics at Chernogolovka, where he set up a laboratory of optics and spectroscopy that is now engaged in a number of areas in the spectroscopy of crystals. At this time, Broude's personal scientific interests were becoming increasingly closely linked to the spectroscopy of molecular excitons at high levels of excitation of the crystals, and he devoted much time to development of the experimental technique with powerful nanosecond pulses that was required for these studies. He was successful, and during the last few years Broude and his colleagues discovered strong phonon pulses that occur on relaxation of strongly excited anthracene and a new emission band that may indicate the formation of a dense molecular-exciton phase.

Broude's contribution to science is not exhausted by his personal achievements. His broad scientific interests, exceptional amiability, and personal charm enabled him to get along easily with a wide variety of personalities, and he willingly shared his experience and advice with colleagues and first-year students alike. He left behind him many students whom he had always tried to imbue with his passionate dedication to science, his untiring interest in everything new that caught his eye. These were the qualities responsible for Broude's enormous contribution to the forming of the scientific staff of the USSR Academy of Sciences Institute of Solid State Physics. Until very recently, gravely ill and knowing that his illness was incurable, Broude continued to work actively and with surprising courage and enthusiasm.

The work of Vladimir L'vovich Broude left a clearly marked trail in his science, and his memory will forever be preserved in the hearts of his friends and colleagues.