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THE 100TH BIRTHDAY OF LEV LANDAU

>>> HISTORY

Lev Davidovich Landau is one of the most versatile and influential theoretical physicists of the 20th century. He was born on 22 January 1908 in Baku, a capital of Azerbaijan, at the time part of the Russian Empire. His parents were educated people. His father was an engineer in the oil fields of the Caspian Sea, his mother a medical doctor, taking care of the family. As a child he has shown an unusual fascination with mathematics, but was also fond of Russian poetry, Lermontov in particular. He went quickly through the schooling system and readily entered University of Baku at the age of 14 to study physics and mathematics, and in parallel chemistry. Expectedly this was met with some suspicion from the fellow students until they realized that the young boy was competent enough to provide them with assistance in their studies. After two years he followed his sister to continue his studies in Leningrad, at that time the most developed center for physics in the Soviet Union. At the age of 19 he got the diploma of physicist and already had his first published paper - On the theory of spectra of diatomic molecules, *Zeitschrift für Physik* 40, 621 (1926).

He continued to work at the University in Leningrad until 1929, when a scholarship from the Peoples Commissar for Education (equivalent to Minister of Education) enabled him to go abroad on an 18 months visit to Berlin, Göttingen, Leipzig, Copenhagen, Cambridge and Zurich where he met many of the most prominent physicists of that period: Born, Heisenberg, Bohr, Dirac, Pauli. The longest stay was in Copenhagen where a relationship with Bohr developed whom Landau considered as his teacher ever since. The seminars at Bohr's Institute and those organized by Yakov Frenkel' in Leningrad completed the education of Landau. Together with Gamov he proposed to establish in Leningrad an Institute of theoretical physics on the model of the Institute in Copenhagen, but the idea did not get support.

For five years (1932-37) Landau was in Kharkov, affiliated to the Ukrainian Physical and Technical Institute (UFTI). UFTI was established in 1928 and its core of talented young physicists came mostly from Leningrad. The director of UFTI and dean

of the Physical and Mechanical Faculty was I. V. Obreimov, who offered Landau the leadership position of the theoretical section with full freedom of action. In 1934, without formal defense of a thesis he is awarded a degree of Doctor of physical and mathematical sciences and next year, at 27, he becomes a full professor. Here he starts with his educational activities which extend far beyond the walls of his new Institute. According to the reminiscences of two students of Kharkov University, Y. Feinberg and B. Verkin, who later became members of the Ukrainian Academy of Sciences, after



▲ Conversation between two Nobel laureates, Murray Gell-Mann and L. D. Landau (on the right) at a conference held in Moscow in 1956.

a few lectures at the beginning of semester in 1935 given by the dean of the Faculty, professor A. V. Zhelehovskiy, he introduced to the students a young man who would replace him and would continue with lectures in General Physics. At first the students were surprised by the unusual exposition of the material, but became convinced later that they had been lucky to be exposed to such an outstanding set of lectures. They were not so appreciative of Landau's way of examination. Even less so was the administration. Landau was summoned to the rector, a few words were exchanged which lead to a treat of firing. Colleagues, however, showed solidarity with Landau and refused to continue teaching. The 'strikers' were invited to Kiev where they had a meeting with the entire Ukrainian government. But Landau decided to leave anyway. During his stay in Kharkov three large conferences were organized and many physicists from abroad paid visits, Niels Bohr, Victor Weisskopf, Paul Dirac, Waller, Rosenfeld and others.

His next step was Moscow and the Institute of Physics Problems headed by Kapitza. After one year, in the spring of 1938 Landau was arrested. He spent one year in prison and was released after the interventions to the highest authorities by Kapitza who insisted that only Landau was able to explain his experiments with liquid helium.

He has written 115 scientific papers, about half of them as coauthor. The publications appeared at an average rate of little over three papers per year. His most productive year was 1937 with 10 publications. Only in 1952 and 1953 he did not publish anything when he was involved in the project of the Soviet nuclear weapon.

The largest portion of his publications is connected to condensed matter and includes a development of a theory of phase transitions of second order, with extensions to the theory of superconductivity (with V. L. Ginzburg), theory of superfluidity, diamagnetism of electrons, theory of quantum liquids and plasma oscillations, properties of metals. Other fields that he addressed are cosmic rays, quantum electrodynamics, properties of nuclear matter, non-conservation of parity in beta decays. The list is not exhaustive.

In parallel to his scientific work Landau envisaged a large project of an encyclopedic course of theoretical physics. The course includes ten volumes of approximately 5000 pages coauthored with E. M. Lifshits, the last three being written by Lifshits, Berestetskii and Pitaevskii. They were translated into many languages and made an influence throughout the world. Closely related to this fundamental treatise is the creation of the Landau school of theoretical physics. He envisaged a system of examinations known as Landau minimum which included 2 exams in mathematics and 7 exams in different branches of theoretical physics. During 25 years, the exams have been passed by 43 physicists and the very first (1933-35) to succeed were A. S. Kompaneets, E. M. Lifshits, A. I. Akhiezer, I. Y. Pomeranchuk and L. Tisza.

Landau received many recognitions, among them the highest awards in his homeland. He was member of the Academies of the Soviet Union, United States, Netherlands, Denmark and Fellow of the Royal Society in London. The 1962 Nobel prize was awarded to Landau "for

his pioneering theories of condensed matter, especially liquid helium”.

His character had a strong note of sharpness, both toward more junior and senior people. Such exchanges caused his move to and from Kharkov, although in the second case other considerations could have played a role. At the door of his office in Kharkov below his name, he himself had posted a warning “*Be careful, he is biting*”. But what characterized him most was perhaps his ability for work and his efficiency. He was married to Kora Dobryantseva and they had one son, Igor.

In January 1962 on the way from Moscow to Dubna, after a collision Landau was close to death. The efforts of medical staff and many others succeeded to keep him alive. It is difficult to describe in a few words all the efforts of doctors, physicists and others from the entire world providing help for Landau. Pilots delivered medicaments on the tarmacs of the airports to be brought quickly to the hospital, special equipment was constructed, specialists from other countries

were consulted, physicists organized shifts on duty for continuous and quick communications. It was a rare display of unity in the world at a time when it was highly divided. Landau recovered from the catastrophe although not entirely to be able to continue with his research. He died on 1 April 1968.

To commemorate the 100th anniversary of Landau, the Russian Academy of Sciences had a scientific session of its Physics Department (22-23 Jan. 2008). The Academy hosted a Memorial Meeting (19-20 June 2008) and the Landau Institute for Theoretical Physics organized the L.D. Landau Memorial Conference (22-26 June 2008), both with strong participation of invited speakers from outside Russia. Two conferences dedicated to Landau were organized in Kharkov, one around the theme of Problems of Solid State Physics (11-13 Dec. 2007) and one with memorial lectures, scientific reports and reports of young scientists (15-16 Jan. 2008). The Ukrainian national bank issued a coin of two grivna to commemorate the scientist.

At the beginning of his scientific career, when quantum mechanics was born, Landau had the feeling that he was born too late when the most significant discoveries had already been established. Knowing his achievements perhaps one could wonder whether he was not born too early and what would have been his contributions to the vast knowledge of modern science.

Among several biographies of Landau, the work of his niece Maya Bessarab, which had several editions, holds a prominent place. The first 1971 edition begins with a citation from a letter of Landau to Maya: “It is most important to do everything with enthusiasm, it embellishes life enormously”. ■

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G. F. BASSANI (1929-2008) »»» OBITUARY

Giuseppe Franco Bassani, a chief founder of the modern Italian condensed-matter theory school, died in Pisa on September 25, 2008. Born in 1929 in Milan, Bassani received his training in the early 1950s at the University of Pavia, under the influence of the theoretical school of Piero Caldirola. He then worked in the US, at the University of Illinois at Urbana-Champaign, where he regarded himself a student of Frederick Seitz, and later at Argonne National Laboratories. Of this early period are his seminal contributions that helped create and establish modern electronic theory of solids based on pseudopotentials and explain the connections between electronic structure and optical properties, especially of semiconductors. Upon his return to Italy in 1963, he conducted and encouraged vigorous research, raised students, and established lively condensed matter theory groups at the Universities of Messina, Pisa, Rome (La Sapienza), and finally at Pisa's prestigious Scuola

Normale Superiore – an institution which he eventually directed from 1996 to 1999.

Theory groups in Trieste, at the International Centre for Theoretical Physics, at the University, and at the International School for Advanced Studies owe a great deal to his influence, as does the group at the Ecole Polytechnique Federale of Lausanne. A staunch believer and supporter of Italian and European physics in all its manifestations, he also served as President of the Condensed Matter Division of the European Physical Society (EPS) from 1984 to 1992 and President of the Italian Physical Society from 1999 to 2007.

His contributions include among many other themes the theory of color centres in ionic crystals, the theory of excitons, the electronic structure and optical properties of layered compounds, and the theory of non-linear optical properties.

A member of Italy's Accademia Nazionale dei Lincei and a Fellow of the American Physical Society and of the Institute of Physics of the U.K., Bassani received



important recognitions and awards, including the Somaini Prize, the Italgas Prize, the Italian Presidential Gold Medal for Science and Culture. Giuseppe-Franco Bassani was elected Fellow of the EPS at the Council meeting in Mulhouse in March 2008 *for his fundamental contributions to the theory of the electronic states of solids and to the explanations of their optical properties*.

A teacher, mentor and colleague of great rigor, vigour and principles coupled with an extremely warm human tract, Bassani was much respected in the community and beloved by his numerous students, now spread around various institutions in Europe and abroad. ■

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