Publisher's Note

Contemporary Biographies in Physics is a collection of thirty-one biographical sketches of "living leaders" in the fields of physics. All of these articles come from the pages of *Current Biography*, the monthly magazine renowned for its unfailing accuracy, insightful selection, and the wide scope of influence of its subjects. These up-to-date profiles draw from a variety of sources and are an invaluable resource for researchers, teachers, students, and librarians. Students will gain a better understanding of the educational development and career pathways—the rigors and rewards of a life in science—of the contemporary scientist to better prepare themselves for a scientific career.

The geographical scope of *Contemporary Biographies in Physics* is broad; selections span the Eastern and Western Hemispheres, covering numerous major geographical and cultural regions. While most of the figures profiled are practicing scientists in their respective fields, the selection also includes scientifically trained government officials, institutional directors, and other policy leaders who are helping to shape the future of science by setting agendas and advancing research. Scientific fields covered range from biophysics and astrophysics, to electronics and mechanical engineering, to climatology, meteorology, and oceanography.

Articles in *Contemporary Biographies in Physics* range in length from roughly 1,000 to 4,000 words and follow a standard format. All articles begin with ready-reference listings that include birth details and concise identifications. The articles then generally divide into several parts, including the Early Life and Education section, which provides facts about the scientists' early lives and the environments in which they were reared, as well as their educational background; and Life's Work, a core section that provides straightforward accounts of the periods in which the profiled subjects made their most significant contributions to science. Often, a final section, Significance, provides an overview of the scientists' places in history and their contemporary importance. Essays are supplemented by bibliographies, which provide starting points for further research.

As with other Salem Press biographical reference works, these articles combine breadth of coverage with a format that offers users quick access to the particular information needed. For convenience of reference, articles are arranged alphabetically by scientists' names, and an appendix lists scientists' names by their country of origin. In addition, a general bibliography offers a comprehensive list of works for students seeking out more information on a particular scientist or subject, while a separate bibliography of selected works highlights the significant published works of the scientists profiled. An appendix consisting of ten historical biographies of "Great Physicists," culled from the Salem Press *Great Lives* series, introduces readers to scientists of historical significance integral to the genesis of physics and whose work and research revolutionized science.

The editors of Salem Press wish to extend their appreciation to all those involved in the development and production of this work; without their expert contribution, projects of this nature would not be possible. A full list of contributors appears at the beginning of this volume.

Abrikosov, Alexei

Russian physicist

Born: June 25, 1928; Moscow, Russia

On October 8, 2003, Alexei A. Abrikosov, along with Vitaly L. Ginzburg and Anthony J. Leggett, was awarded the Nobel Prize in Physics for his pioneering contributions to the theory of superconductivity. He earned the award because he had explained theoretically how "Type-II superconductors allow superconductivity and magnetism to exist at the same time and remain superconductive in high magnetic fields," as the press release from the Nobel committee read. In addition to the Nobel Prize, he has been honored with the Lenin Prize (1966), the Fritz London Award (1972), the USSR State Prize (1982), the USSR Academy of Sciences' Landau Award (1989), and the International John Bardeen Award (1991). Abrikosov has also received France's Honorary Citizenship of Saint Emilion. In 1975 he received an honorary doctorate from the University of Lausanne, in Switzerland. In 2001, he was elected to the Royal Society of London as a foreign member.

Early Life and Education

Alexei Abrikosov was born on June 25, 1928, in Moscow, Russia. After graduating from Moscow State University in 1948, Abrikosov was admitted to the Kapitsa Institute for Physical Problems in Moscow. In 1951 he earned a doctorate in physics from the Institute on the basis of his dissertation, which explored the theory of thermal diffusion in plasma. Four years later, Abrikosov received his second doctorate in physics from the Institute for his dissertation on quantum electrodynamics at high energies.

Life's Work

As a research associate with the Kapitsa Institute, Abrikosov began conducting research into the phenomenon of superconductivity. In

1911 the Dutch physicist Heike Kamerlingh Onnes (1853–1926) discovered superconductivity by cooling mercury to a few degrees above absolute zero and observing that electrical resistance in the metal disappeared. Kamerlingh Onnes's discovery earned him the Nobel Prize in Physics in 1913. In 1950 two Russian physicists, Vitaly Ginzburg and Lev Landau, published a scientific paper that offered a theory of how superconductivity worked. Ginzburg and Landau devised mathematical equations that explained why superconductivity and magnetism could coexist in some superconducting materials, but not others. (Landau won the Nobel Prize in Physics in 1962. Ginzburg shared the Nobel Prize in Physics in 2003 with Abrikosov and Anthony Leggett, a British physicist.) Abrikosov's colleague and roommate at the Institute, Nikolay Zavaritskii, began measuring the critical magnetic field of thin superconducting films to see if Ginzburg and Landau were correct in predicting their behavior. "[Ginzburg's and Landau's theory] and experiment fitted perfectly, including the change of the nature of the transition: first order at larger thickness and second order at smaller ones," Abrikosov recalled in his Nobel lecture, as posted on the Nobel e-Museum website. Zavaritskii's supervisor, Alexander Salnikov, was not satisfied with the results, however, because the young physicist had used films that were prepared at room temperature. "The atoms of the metal, evaporated on a glass substrate, could agglomerate, and there the film actually consisted of small droplets," Abrikosov recalled in his lecture. "In order to avoid that, Salnikov recommended to maintain the glass substrate at helium temperature during evaporation and until the measurements were finished. Then every metal atom hitting the surface would stick to its place, and the film would be homogeneous." When he tried the experiment again, following Salnikov's instructions, Zavaritskii found that the results did not confirm Ginzburg's and Landau's predictions. "Discussing these results with Zavaritskii, we couldn't believe that the theory was wrong: it was so beautiful, and fitted so well [with] the previous data," Abrikosov said in his lecture. "Therefore we tried to find some solution in the framework of the theory itself." Abrikosov found that the Ginzburg-Landau parameter, which formed the basis of the two physicists' equations, had small values because they were calculated from the surface energy between the normal and superconducting phases of the superconductor. When the value of the parameter was increased, the surface energy between the normal and superconducting phases became negative. Ginzburg and Landau kept the value of their parameter small because the existence of negative surface energy contra-

"With his theory of vortices, Abrikosov invented a whole new discipline."

dicted the existence of the intermediate state in a superconductor. Abrikosov experimented with negative surface energy and discovered that the transition was of the second order for superconducting films of any thickness. He concluded that a special type of superconductors existed, which he and his colleagues called superconductors of the second group. These eventually became known as Type-II superconductors. Ginzburg and Landau had used Type-I superconductors, which expel magnetic fields, in their experiments. By contrast, Type-II superconductors allow superconductivity and magnetism to coexist. In 1952 Abrikosov published his findings in a Russian scientific journal.

Abrikosov then devoted his attention to examining the magnetic properties of Type-II superconductors. "The solution of the Ginzburg-Landau equation in the form of an infinitesimal superconducting layer in a normal sea of electrons was already contained in their paper," Abrikosov wrote in an article for *Physics Today* (January 1973). "Starting from this solution I found that below the limiting critical field, which is the stability limit of every superconducting nucleation, a new and very popular phase arose, with a periodic distribution of the [wave] function, magnetic field, and current. I called it the 'mixed state.'" Abrikosov devised mathematical equations that explained how a magnetic field successfully penetrated Type-II superconductors and was able to coexist with superconductivity. "By an insightful analysis of the Ginzburg-Landau equations he was able to show vortices may form in the spatial distribution of the order parameter and how a magnetic field through these can penetrate the superconductor," Professor

Mats Jonson said in his presentation speech to the Nobel laureates, as posted on the Nobel e-Museum website. “The vortices are essentially of the same type as those we can see form in the water when we empty a bath tub.”In 1953 Abrikosov shared his theory with Landau. Although he was initially intrigued by Abrikosov’s research, Landau strongly rejected the idea that vortices allowed magnetism to penetrate the superconductor. Abrikosov decided to postpone publishing his paper. “I put it in a drawer, but I did not put it in the wastepaper basket because I believed in it,” he recalled to Jeremy Manier and James Janega for the *Chicago Tribune* (October 8, 2003). In 1957 Abrikosov finally published his paper in a Russian scientific journal. He also read the paper at a conference in Moscow that was attended by several British physicists. “Nobody understood a single word,” Abrikosov recalled in his article for *Physics Today*. “This could be explained however, by the fact that I had a terrible cold with high [fever] and had hardly had any idea myself of what I talked about.” The same year, Abrikosov’s paper was translated into English and published in the *Journal of Physics and Chemistry of Solids*. Unfortunately, the translated article contained numerous errors in the equations and the text.

Abrikosov’s work, however, was gradually vindicated, as more Type-II superconducting metals, which can carry more electricity than Type-I materials, were discovered during the 1960s. “With his theory of vortices, Abrikosov invented a whole new discipline,” Brian Schwartz, the vice president for research at the Graduate Center of the City University of New York (CUNY), told Guy Gugliotta for the *Washington Post* (October 8, 2003). “If you read his [1952] paper today, you’ll see it has everything. You’re just amazed at how much he did.”

Significance

Superconductivity has led to numerous technological advancements, including magnetic resonance imaging (MRI), which provides medical doctors with high-resolution scans of the human body; particle-beam accelerators; and high-speed magnetic levitation trains.

Abrikosov was eventually named a senior scientist at the Institute of Physical Problems. In 1965 he became the head of the L. D.

Landau Institute of Theoretical Physics of the Academy of Sciences in Moscow. Abrikosov has also taught at Moscow State University, Gorky University, and the Moscow Physical English Institute. In 1988 Abrikosov became the head of the Institute of High Pressure Physics in Moscow. Disillusioned by life in the Soviet Union, Abrikosov came to the United States in the spring of 1991, months before the collapse of the USSR. He joined the Argonne National Laboratory in Illinois, as the Argonne Distinguished Scientist at the Condensed Matter Theory Group of the Materials Science Division. Explaining his decision to immigrate to the United States, Abrikosov told Margaret Shapiro for the *Washington Post* (November 23, 1991), "If you spend all day trying to get a car fixed and trying to find food, it doesn't stimulate theoretical research." At the Argonne National Laboratory, Abrikosov has pursued research in the fields of high-temperature superconductors and colossal magnetoresistance (CMR) manganates.

Arbikosov has published several books on physics and numerous scientific papers. He and his wife, Svetlana, are the parents of three children. Abrikosov lives in Lemont, Illinois.

Further Reading

Abrikosov, A. A. "My Years with Landau." *Physics Today* Jan. 1973: 56–60. Print.

"And the Nobels go to … Illinois." *Chicago Tribune* 8 Oct. 2003: 1. Print.

Shapiro, Margaret "Ablest Soviets Flee for Better Lives; Economics, Not Dissidence, Fuels Accelerating Brain Drain." *Washington Post* 23 Nov. 1991: A1. Print.