Kapitsa's Visit to England

London. Piotr L. Kapitsa's visit to England in May was something more than a sentimental tour punctuated by an address paying tribute to Lord Rutherford, head of the Cavendish laboratory at Cambridge when Kapitsa worked there from 1921 to 1934.

Kapitsa turned the visit into a moving demonstration of the kind of breezy, almost playful openness that must accompany the best scientific work. A wide audience that had never known Kapitsa could see the intellectual freshness that had made him a magnet for young physicists at the Cavendish, had permitted him to continue his work despite being forced to remain in the Soviet Union in 1934 and deprived of his Moscow institute in 1944, and had driven him to keep working on, and talking about, such problems as scientific education in the Soviet Union and world disarmament.

In other words, Kapitsa's visit gave an impressive glimpse of an important scientist who could have been pulled apart by nonscientific forces but who has survived and continues to speak with a strong voice in his own country.

He has recently made public declarations about the steps needed to reduce the lag of Soviet science behind U.S. science and has signed a petition against any attempt to "rehabilitate" Stalin. In addition Kapitsa is taking part in a public campaign to prevent construction of a large industrial complex that would pollute Lake Baikal, a huge and exceptionally deep lake in Siberia. Kapitsa, several painters and writers, a vice president of the Soviet Academy of Sciences, and 19 other academicians signed a letter to *Komsomolskaya Pravda* that was published while Kapitsa was in England. The letter is regarded as a highly unusual challenge to the judgment of important officials, whom it accuses of having wasted "colossal" sums on pulp mills and cellulose plants which would use Lake Baikal as an "experimental reservoir for an untried water purifying system, inapplicable in such severe climatic conditions." Thus, the present exceptional purity of Baikal's water would "inevitably" be lost, the authors of the letter assert.

On his 3-week visit, Kapitsa spoke frequently. He lectured at the University of Cambridge on the problem of selecting highest-level talent, and on the work at the Institute of Physics Problems (in Moscow), which he heads. He was interviewed on television by an old scientific colleague, Sir Edward Bullard of the department of geodesy and geophysics at Cambridge. On the initiative of his host, Sir John Cockcroft of Churchill College, the Royal Society invited scientific reporters to a press conference with Kapitsa.

Of course, Kapitsa had to be circumspect about dragging up the past. At the Royal Society press conference an Asia journalist asked him adroitly if, after he had returned to the Soviet Union for good in 1934, he had felt "isolated."

Kapitsa was silent for a moment. Then his eyebrows went up. Smiling slightly, he said, "These are such romantic questions!"

For the moment, he dropped the question, but he found a way to refer to it in his talk about Lord Rutherford. He spoke of Rutherford's sensitivity to the psychology of creative researchers and noted that, in the 3 years after he himself had become "unable to return to Cambridge," Rutherford was the only scientist with whom he freely corresponded outside Russia.

Rutherford in his letters gave him, said Kapitsa, "an account of life in Cambridge, spoke about the scientific achievements of himself and his pupils, wrote about himself, made jokes, gave good advice and invariably cheered me up in my difficult position."

"He understood," Kapitsa said, "that the important thing for me was to start my scientific work which had been interrupted for several years. It is no secret that it was only due to his interference and help that I was able to obtain the scientific installation and apparatus of the Mond Laboratory [the special laboratory set up for Kapitsa at the Cavendish] and in 3 years' time I was able to renew my work in the domain of low-temperature physics" (*Nature*, 21 May).

In the same lecture Kapitsa took the opportunity to inferentially establish his loyalty to the official ideology of the Soviet Union. He said:

> When I became a Fellow of Trinity [in the 1920's] and used to accompany [Rutherford] home after dinner on Sundays, we often discussed politics. On the first day I started work in the Cavendish I was surprised to hear him saying to me that in no circumstances would he tolerate my making Communist propaganda in his laboratory. At the time this remark came quite unexpectedly. It not only surprised me, but also shocked me and to a certain extent even offended me. Undoubtedly it was a consequence of the current atmosphere of acute political struggle and was connected with the propaganda which existed in those days—only four years after the Russian revolution. Before coming to England, I was so absorbed in my research work in Russia that I was completely unaware of what was happening in Western Europe and could not appreciate the scale of the bitter political controversy which then existed.
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> Later on when my first experimental research was published I presented Rutherford with a reprint and I made an inscription on it that this work was proof that I had come to his laboratory to do scientific work and not to make Communist propaganda. He became extremely angry with this inscription, swore and gave me the reprint back. I had foreseen this and I had another reprint in reserve with an extremely appropriate inscription which I immediately presented him. Obviously Rutherford appreciated my foresight and the incident closed. Rutherford had a characteristically hot temper but cooled down just as quickly.

The incident shows an impish streak in Kapitsa. This quality is still evident. At the Royal Society press conference, Kapitsa was asked if he felt there should be more visits to Russia by members of the British technical press. In answering this he included all classes of scientific exchange: "I think people must come and go." He added that he felt peace would be assured if Western defense scientists visited secret Soviet laboratories and Soviet defense scientists did the same in the West. But he smilingly acknowledged that this plan wouldn't come into effect for some time.

When he visited the Cavendish laboratory he cleared up years of speculation about the origin of a carving of a crocodile on the wall of the Mond Laboratory. "It was my idea that the crocodile should be incorporated in the building to represent Lord

Rutherford. In Russia the crocodile represents the father of the family."

Kapitsa had serious things to say, however. He gave much attention in speeches and interviews to the proper selection of talented scientists and the proper conditions for their work.

Asked if it would be possible to maintain quality when the scientific manpower pool was expanding so rapidly, Kapitsa responded, "It is not sufficient to have money. One must have brains. To pick people with creative minds is the crucial question."

With a smile he told reporters that America solved her problems by "draining" British brains. "We have nobody to drain," he said. So it was necessary to try such expedients as establishing a special institute in Moscow where students get 2 years' general training in theoretical aspects of science, including laboratory work, before moving on to work in one of the 40 to 50 collaborating research institutes. The special institute will celebrate its 20th anniversary this year.

The main difficulty faced by the special institute is a lack of first-class equipment in the universities, Kapitsa said. The universities have the necessary professional teachers but they lack money for equipment. Thus, after completing an ordinary university education, the young scientist faces an entirely new situation when he arrives at a research institute of the Academy of Sciences.

By giving the laboratories of these research institutes a role in the teaching of the special institute, Kapitsa said, one avoids the expense of equipping special laboratories merely for teaching, trains the student in the use of the latest equipment, and gives the researchers the benefit of teaching experience. "In training people, you learn something yourself," Kapitsa noted.

When the special institute was established, in 1946, many were skeptical, Kapitsa said, "but it has proved to be much better than any other."

One of those who figured in its establishment was Academician M. A. Lavrentyev, who followed many of its principles in linking the research laboratories at the Siberian science center of Akademgorodok with the university of Novosibirsk and a special science boarding school nearby.

Kapitsa said the Soviet ministry of education is considering establishment of several more institutes on the Moscow model.

In selecting students for the Moscow institute, Kapitsa said, it is important to get people from places other than Moscow and Leningrad. Hence, representatives go out to many regions to make a first screening of candidates. A later selection is made in Moscow.

After the first 2 years the students, who are in three fields—mechanics, physics, and chemistry—are given examinations to select those who will go on to laboratory research. In physics, the examination consists of three questions; one of these the student sets himself, the other two are mandatory. But during the 2-hour examination the student may consult anyone or any book. "There is no chance to memorize," Kapitsa said. "I am told the exam is very difficult."

At the press conference Kapitsa, speaking of the proper environment for research, observed that little had changed at Cambridge since his departure. He smiled as he said this; so did the British science reporters. He added, "This country is the champion of basic science. The organization of basic research is extremely well done here. But such institutions cannot be used for applied research.

"Basic research is international. It is not classified. All over the world one has the same basic problems."

Among these problems is the application of research results in industry. He stressed this in his well-known *Komsomolskaya Pravda* article, in which he pointed to a lag in Soviet research. He noted that the economic and industrial benefits of the massive commitments to research have been insufficient. In proposing remedies, Kapitsa put much stress on the personal attitudes of scientists and industrialists:

> In organizing the process of assimilation of new technologies by industry, the approach must be purely individual, without any cut and dried rules, and the character of the people concerned and the nature of the external conditions must be taken into account in each particular case. Questions of finance and personnel are, of course, settled by an appropriate decision, but the useful assimilation of new technologies depends on good relations between pupils and teachers and on their common interest in success.

Kapitsa was asked if Soviet scientists felt that space exploration was absorbing too much money or too many people. He replied that the real problem was lack of people; one could increase the expenditure tenfold and expect only to double the real output. "The amount of real ability in a country remains constant while the gross income rises." But were too many people committed to the Soviet space effort? Kapitsa said no: the answer to such questions was provided by national purposes. How, for example, could Americans justify their military intervention in Vietnam, Kapitsa asked.

Did Kapitsa think there should be joint efforts by the Soviet Union and the United States to reduce the cost of voyages to the moon and to Mars? He replied, "Some sort of competition should be left. Every problem has a number of different solutions before you find the right one. One must try several. Competition stimulates research. Collaboration helps in some fields but I doubt if it does so in basic, creative research."

Kapitsa also volunteered the opinion that the Soviet Union was "a little ahead" in the competition. (In his television interview with Sir Edward Bullard, Kapitsa acknowledged that he had been "consulted" on the Soviet space program, but he disclaimed any leading role.)

Another important problem in trying to create the best conditions for science is the communication of scientific information among scientists and to the general public. Kapitsa said the aspect of this problem which interests him most is "propaganda," or the arranging of contacts "between different fields of science—say, between physics and biology or between mathematics and mechanics. As an institute director, Kapitsa tries to arrange such contacts.

As for his own recent research interests, Kapitsa said he was "just an old man with a big laboratory to direct." The Institute of Physics Problems concerns itself chiefly with superconductivity, superfluidity, and microwaves.

Kapitsa expressed particular interest in the application of such research to the transmission of electric power over great distances. This is the topic of the last paper of volume 2 of Kapitsa's collected works; volume 2, which covers his research since 1934, was published recently by Pergamon Press.

Kapitsa urges that much more work be done on transmission of large amounts of electric power—say, 1000 megawatts—through use of wave guides. But he acknowledges that the use of wave guides for transmitting

power will not come into its own until "one invents superconductors at room temperature or temperatures close to it."

Kapitsa sees a "terrific future" for such applications of low-temperature physics as the development of superconductors which will permit economical production of strong magnetic fields in accelerators or electric power systems, microwave transmitters, and magnetohydrodynamic generators. In such applications his own basic research on magnetism and low temperatures, done in the 1920's and 1930's, would be of great significance.

Nonetheless, Kapitsa did not express an expansive feeling about the development of physics. In his lecture on Rutherford, he said:

> The year that Rutherford died (1938) there disappeared forever the happy days of free scientific work which gave us such delight in our youth. Science has lost her freedom. Science has become a productive force. She has become rich but she has become enslaved and part of her is veiled in secrecy.
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> I do not know whether Rutherford would continue nowadays to joke and laugh as he used to do.
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> —VICTOR K. MCELHENY

Oceanography in Britain: Significant New Support

London. The British government's support for physical and biological studies of the sea has increased rapidly during the 1960's, especially for the budget year beginning 1 April 1966. These increases are responses to steady lobbying by the scientific community, although this lobbying was quieter than similar efforts in the United States.

By 1964–65 the budget for civilian marine science in Britain had risen to a total of $6 million (compared to nearly $20 million in France and $70 million in the United States); it is now nearer $10 million. The National Institute of Oceanography at Wormley in Surrey has been particularly favored. From an initial budget of about $280,000 in 1949, the institute's spending rose to $740,000 in 1962–63. In subsequent budget years the figure has risen to $1 million, $1.15 million, $1.47 million, and now $1.96 million.

Money has been provided to add a new wing to the NIO building. The increased budgets also make it unlikely that NIO's 3000-ton research vessel *Discovery*, built in the early 1960's at a cost of about $2.3 million, will have to be laid up between expeditions—as she was in 1964 after her initial cruises to the Indian Ocean.

An important factor in the recently increased support for oceanography has been the formation of a special government granting agency for the earth sciences: the Natural Environment Research Council, which was established in 1965 during the general regrouping of British government agencies supporting science and technology. Under the chairmanship of Sir Graham Sutton, retired head of the Meteorological Office, the NERC took over Nature Conservancy, the Geological Survey and Museum, the Hydrology Research Unit, the National Institute of Oceanography (previously supported in part by the Navy), and the Development Commission's responsibilities for marine and freshwater biology and fisheries research.

During the budget year ending 31 March, NERC grants for fisheries research were $1.9 million; this year they are to be $2.25 million. In the broad field of earth-sciences grants, some of them for oceanography, NERC handed out $1.4 million last year; this year, the total will be $1.7 million, an increase of more than 20 percent.

Even more encouraging than the figures has been NERC's determination to remedy two of the major defects of oceanography in Britain: lack of university programs in the field and lack of attention to manned underwater research vessels.

In both physical and biological studies of the oceans, research work had tended to concentrate outside the universities in such establishments as NIO. NIO was particularly notable for its studies of waves (important for the design of harbors), of the continental shelf off western Europe (for which a precision echo sounder was developed to study bottom sediments), and of deep currents in the open ocean (for which the famous neutrally buoyant float was developed). Biological studies were strongest in the laboratories of the Marine Biological Association at Plymouth, the Department of Agriculture and Fisheries for Scotland at Aberdeen, the Scottish Marine Biological Association at Edinburgh, and the Ministry of Agriculture, Fisheries, and Food at Lowestoft. The Edinburgh laboratory was notable for detailed surveys of plankton distribution in the North Sea.

University programs tended to be small except at the University College of North Wales (which received a $250,000 authorization for a biology-research vessel in 1962–63), the University of Liverpool (noted for its studies of tides), and the department of geodesy and geophysics at the University of Cambridge (which has concentrated on studies of the sea floor).

In 1965 the new NERC bought the 120-ft trawler *Noblesse* from the White Fish Authority for conversion to a research vessel for university departments; she is being reequipped with instruments, live-storage space for specimens, and living and working space for scientists. The refit is supervised by a committee headed by the late M. N. Hill of the department of geodesy and geophysics at Cambridge. In a letter to the London *Times* last October, Hill said he hoped that *Noblesse* would be the first of five such vessels that would cost about $5.6 million to buy and convert and about $560,000 annually to operate.

There are also plans for assisting universities to expand their graduate programs in oceanography. It is hoped that more universities will allow doctoral students to have their work supervised at NIO and other institutions.

Undersea research by men received considerable impulse in the summer of 1965 when British graduate students took part in a cooperative program of diving in an especially clear part of the Mediterranean off Malta. During the 1966–67 budget year, the White Fish Authority will rent from America a diving apparatus for fisheries research, which will be the first manned undersea craft used by the British. Scientists will be able to see how various types of fishing gear operate when they are dragged through the water, and how schools of fish react to the gear.

Criticism of Britain's earlier lack of