to 9,000,000 in number and of larger size than at sea-level. The number of reticulocytes is increased also. There is a slight leukocytosis and essinophilia. There is a predominance of monocytes. Alterations in the process of clotting are observed. One patient had bleeding of the gums, but this disappeared as he went down to a lower level. In another case the patient had convulsive attacks accompanied by pupura and the presence of blood in the cerebrospinal fluid, all of which disappeared when he was brought down to sea-level. The bilirubin is highly increased. The pH of the serum diminishes during asphyxial attacks, while after the crisis has passed, it goes up to 7.50–7.70 (Aste-Salazar[1]). The alkaline reserve of the plasma is greater than that of a person who is acclimatized to high altitude. The concentration of hemoglobin in the blood is considerably increased, in one case reaching 179 per cent. (taking 100 as the value found at sea-level). The viscosity of the blood is increased. There is high blood volume (Hurtado) and diminished plasma volume. The oxygen saturation of the arterial blood is considerably decreased. Hurtado found 57 per cent. in one case, and Aste from 70 to 80 per cent. High venous blood saturation reaches normal levels when the patients improve at sea-level. High basal metabolism is found in severe cases.

Evolution of the Disease. As a rule the patients consult a physician only after the illness has been present for some time, and it can last usually from two to twenty years. Sometimes a patient becomes temporarily well even while staying at a high altitude. Usually, after a stay at sea-level a patient returns to a high altitude and lives there for some time without great discomfort. As time goes on, however, the cure at sea-level is less and less enduring, and asphyxial disorders may occur as soon as the patient reaches a high altitude. These disorders may sometimes cause death.

From this condensed description it is seen that the fundamental characteristic of high altitude disease, the characteristic which has made us group it as a nosographic entity, is the fact that all the symptoms subside or disappear as soon as the patient is brought down to sea-level. This feature is undoubtedly due to a common cause, anoxemia. The predominance of any symptom must be due to the fact that the particular organ involved has suffered great damage from the prolonged effects of lack of oxygen.

Besides these severe forms of chronic mountain sickness there are cases of subacute evolution, with slight impairment of physical and psychical conditions and a mild erythremic symptomatology.

At times one can find some individualized forms: pulmonary, cardiac, renal, digestive, etc. But a skilful clinician can always differentiate an erythremic complex. Silicosis, however, frequently displays an exaggerated symptomatology of chronic mountain sickness.

In conclusion it may be said that we have found a climatophysiological variety of human being and a climatopathological variety of human disease. But our work represents only a tentative effort in fields of education and research that are still unexplored.

LOW TEMPERATURE PHYSICS IN THE USSR

By Professor C. T. LANE

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THE extraordinary performance of the Russians on the Eastern Front has been a surprise to many people in this country. We had supposed that most Soviet industry was badly managed and Russian technicians, as a whole, inept. Those of us, however, whose interest in certain scientific fields had compelled us to pay some attention to Russian research were, I think, agreed that much of this work was of a high order and comparable in quality with the best American and British effort. Generally speaking, any nation with a healthy interest in pure research is likely to have a vigorous industry, and *vice versa.*

In the special field of low temperature physics Russian contributions both in the pure and applied domain merit special attention. At least two excellently equipped laboratories for such studies have been built in the past ten years. The best known of these is the Institute for Physical Problems at Moscow under the direction of P. L. Kapitza, but excellent work has also been done at the Physico-technical Institute at Kharkov under W. Schubnikov. It is probably a fair statement of fact to say that Kapitza is the most distinguished of all present-day Soviet physicists. He first appeared in England during the twenties at Cambridge, and, with Rutherford's backing, had very soon perfected an apparatus for the production of magnetic fields some ten times more intense than anything previously attained. During the period 1926–1930 a considerable number of fundamental papers on the properties of metals in high fields appeared from Cambridge. About 1929 Kapitza's interest appears to have shifted to low temperature work, probably because he recognized that such studies

[1] Unpublished work.

would be of prime importance in furthering our understanding of the metallic state. With funds supplied by Sir Alfred Mond he created, practically single-handed, the Royal Society Mond Laboratory at Cambridge for low temperature work. Almost all the equipment at the Mond is of a radically new design, and special mention should be made of the Kapitza helium liquefier there.

This machine marks a new epoch in the technique of gas liquefaction, and for the first time opened up the region of extremely low temperature research to smaller laboratories whose funds do not permit the expensive and highly specialized equipment previously necessary. The Mond liquefier was followed by one of similar type, designed by the writer, and built at the Sloane Physics Laboratory, Yale University.

Apparently Kapitza was in the habit of spending his summers in Russia, and in the fall of 1935 he failed to reappear at Cambridge for the fall term. The story current at the time was that he had been "detained" by the Soviet authorities, who explained that they needed his outstanding talents for Russia's own highly important and rapidly developing scientific work. However, in a letter to the writer in 1937, he stated that he had resumed his scientific work and seemed quite satisfied with his position in general. As head of the Institute at Moscow Kapitza has gone ahead in several directions in the low temperature field. He has built another helium liquefier based on his Cambridge design and equally successful. Although no technical details concerning this plant apparently have been published[1] it appears to be of somewhat better design than either the Cambridge liquefier or the Yale plant, and is probably the best liquid helium equipment in the world to-day.

A second outstanding piece of work has also come from his laboratory, and this merits our special attention since it apparently represents part of a widespread program in the USSR linking low temperature physics and industry. The Russians have instituted a new branch of engineering which they call "deep refrigeration," and much of this program appears to be under Kapitza's direction.[2]

This new industry is really an extension of one which has been practiced all over the world for a number of years (in one restricted field) namely, the production of oxygen, nitrogen and argon from atmospheric air. The Russians have been the first to realize that enormous quantities of valuable raw materials go to waste annually in various gases which are by-products of many industries. The problem has been to separate out the various pure components of these usually complex mixtures and so make available to the chemical industry an abundant source of raw materials for the manufacture of plastics, synthetic rubber, etc. Low temperature separation, *i.e.*, the progressive liquefaction and removal of the various components of a mixture made possible by the fact that each component has a different liquefaction temperature, has been found to be a very economical and practical method. It is clear, therefore, that any advance in the technique of gas liquefaction, while interesting scientifically, is likely to have an even greater industrial significance.

To return to Kapitza, he has recently perfected a new type of liquefaction apparatus which is quite different from anything so far attempted anywhere. While it has officially been applied only to the production of liquid air, it seems certain that the Russians are making wide use of it in their chemical industry, probably in plants making synthetic rubber and explosives. The actual machine, which makes use of a special type of low temperature turbine, is too complicated to be discussed in much detail in such an article as this, although some technical information is available.[3] The suggestion that a turbine might be a valuable type of machine for gas liquefaction is, to be sure, not a new one. It was originally due to the eminent English physicist, Lord Rayleigh, about the close of the last century. However, it soon became apparent that a practical turbine would have to run at an enormous speed, some 30,000 r.p.m., to be efficient, and at such speeds vibration becomes a serious problem. It remained for Kapitza to overcome these formidable technical difficulties, and the resulting apparatus appears from the published accounts to be very reliable and of exceptional efficiency. One enormous advantage lies in the fact that it operates at very low pressure while existing liquefaction equipment does not. This means that for large-scale equipment the cheaper and more efficient turbo-compressor could be used in place of the cumbersome and expensive multi-stage piston compressors now employed. It is probably not too much to say that all existing low temperature industrial equipment has been rendered obsolete by this development. In recognition of the importance of this work the Russian Academy of Sciences voted Kapitza a bonus of 25,000 rubles, together with premiums to his assistants.

While we are on the subject of low temperature physics in industry, it may be worth mentioning that another Russian physicist, M. Ruhemann, has recently published a most illuminating book on the whole subject of gas separation by refrigeration.[4] Ruhemann is a product of the Kharkov Institute and judging by the number of publications by him on the subject which have appeared in various English and Russian

[1] A photograph of the plant appears in *Phys. Zeit. d. Sowjetunion*, 12: 497, 1937.

[2] *Nature*, 148: 360, 1941.

[3] P. Kapitza, *Jour. Physics*, USSR, 1: 7, 1939.

[4] "The Separation of Gases," New York: Oxford University Press, 1940.

journals, he also has taken a leading part in the establishment of this new industry. The book is highly technical, but would certainly repay close study by any one interested in this field.

One instance, apart from gas separation, of some of the problems which have been solved in the USSR should prove of interest to scientists in this country. The so-called "natural gas" found in and adjoining oil fields consists largely of methane. This gas is much superior to ordinary illuminating gas in calorific value, but, more surprising, it is an excellent anti-knock fuel for internal combustion engines. The difficulty lies in storage, since a cylinder designed for 150 atmospheres pressure weighs about ten times more than the methane it contains. However, a tank $20 \times 15 \times 10$ feet could hold as much methane (liquid) as a two million cubic foot gas-holder and would be immeasurably cheaper and less dangerous. The advantages of such a scheme are obviously very great—such stored gas would be of great value in emergencies or when sudden and heavy industrial demands on fuel gas occur.

Despite all this industrial activity in recent years, a good deal of purely "academic" research of high quality has come from Kapitza's laboratory. One such outstanding contribution was made during the current year and reported in the *Physical Review.* This had to do with the properties of liquid helium. Kapitza had earlier discovered that liquid helium at a temperature some two degrees above absolute zero (so-called Helium II) behaves like an "ideal" fluid, apparently possessing a vanishingly small viscosity or fluid friction. It appears from this latest work that Helium II flows in narrow channels without change in entropy and accordingly is truly a super fluid. We must therefore regard this substance as being unique—nothing like it has ever been previously observed. The significance of this discovery for modern atomic physics is likely to be of the greatest importance.

The whereabouts and activities of Kapitza since the German invasion are not known. It is probable that his purely scientific work has been interrupted although likely that he is still engaged in his industrial activities.

THE NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL: THIRD PROGRESS REPORT

By Dr. LEONARD CARMICHAEL

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IN previous reports[1] an outline has been presented of the basic plan and the preliminary steps taken in the construction of the National Roster of Scientific and Specialized Personnel. In the present report emphasis is given to a description of the actual operation of the Roster as it appears at the close of the first year of performance.

So far, more than 200,000 names of individuals are listed in the analytical files of the Roster. It is interesting that from this list already more than 50,000 names have been presented to various defense agencies and other government bureaus for consideration in connection with appointments. Almost all the requests that come to the Roster office are of a confidential character and it is not possible at this time to describe them. It can be said, however, that especially large numbers of demands have been presented for individuals in the fields of physics, electrical engineering, aeronautical engineering, marine engineering and mechanical engineering. Significantly large numbers of requests have also been received for individuals with special language skills or with a combination of some other professional competency and language skill. There have been demands also for a good many economists and psychologists, and, indeed, there have been some requests for men in each of the fields covered by the Roster. The fields for which technical check lists have so far been prepared are as follows:

Administration and Management, including separate lists in:
- Accounting
- Management Engineering
- Personnel Administration

Agricultural and Biological Sciences, including separate lists in:
- Animal Sciences
- Botany
- Forestry and Range Management
- Genetics
- Plant Pathology, Horticulture and Agronomy
- Zoology and Entomology

Engineering and Related Fields, including separate lists in:
- Aeronautical Engineering
- Architecture

[1] SCIENCE, August 16, 1940, Vol. 92, No. 2381, pages 135–137, and SCIENCE, March 7, 1941, Vol. 93, No. 2410, pp. 217–219.