of civilian tuberculosis. Furthermore, a Service man is under constant medical observation, and occult tuberculosis is more readily detected than in civilian life.

At the outbreak of war, there was a temporary dislocation of the tuberculosis services in some areas. There was a shortage of residential accommodation, for some of the sanatoria had to be converted into casualty hospitals, and in the excitement of war conditions, in many instances, advanced and infective patients were sent home contrary to the instructions of the Ministry of Health. The Ministry was able later in the year to release 6,000 beds for the treatment of tuberculosis. In 1940 patients were removed inland from hospitals and sanatoria in the eastern and southern coastal areas under the threat of enemy invasion. During the intensive bombing of London and other large cities, many tuberculosis wards in general hospitals were put out of action. All this has added to the difficulties of adequate residential accommodation, although, as the Minister of Health pointed out in June 1942, the main problem is the shortage of nurses for the tuberculosis service.

Evacuation and shelter life also provided their problems. Arrangements were made to meet evacuated persons' needs for continuation of treatment, and efforts have been made by medical supervision and attention to hygiene to diminish the risk of spread of infection in the shelters. Since the War, there has been an increase in tuberculosis mortality in mental hospitals and mental deficiency institutions.

Experts have pronounced that the present scale of rationing is adequate for the tuberculous, if carefully planned, as in sanatoria and hospitals. The consumptive at home or in lodgings may not be able to secure such a diet, and many think a case for special nourishment can be made out on these grounds.

War conditions are, for many reasons, favouring tuberculosis among all callings. In this increased incidence the factory workers share, but the primary causes of it lie for the most part outside the factory.

Measures of prevention and treatment may be grouped into immediate and future measures. The deadly effects of tuberculous milk are well known, and universal heat treatment of all milk would abolish tuberculosis of bovine origin, which is responsible for about 2,000 deaths in England and Wales annually as well as much suffering, illness, crippling and economic loss. Miniature or indirect radiography is an important aid to early diagnosis, but it reinforces and does not supplant clinical examination. It must not be used as a 'rule of thumb' diagnosis. Recent work in chemotherapy encourages the hope that eventually a drug may be found which will destroy the tubercle bacillus in man (*vide* "Chemotherapy and Tuberculosis", NATURE, October 31, p. 517).

After the War, Great Britain will be faced with a greatly increased incidence of tuberculosis, particularly in ex-Service men. It is high time to marshall all our forces, and the Ministry of Health is already taking active steps. More institutional provision and beds will be needed. The village settlement, which provides the ideal solution of the tuberculosis problem, and other methods of rehabilitation will be required. The Medical Research Council favours the setting up of a national board in order to co-ordinate the planning of a national rehabilitation scheme. This was first advocated by Sir Pendrill Varrier-Jones in 1936. The work and direction of such a board is called for especially at the present time.

MATHEMATICS IN THE U.S.S.R.

By PROF. IVAN VINOGRADOV
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THE development of the science of mathematics in Russia is comparatively recent, beginning with the establishment of the Russian Academy of Sciences in the eighteenth century, when Bernoulli and Euler, leading mathematicians of the time, were invited to Russia. These men, however, remained foreigners, and did not create what may rightly be termed a Russian school of mathematics. Lobachevsky was the outstanding Russian mathematician, and he first propounded theories of non-Euclidean geometry, but he did not found a school of mathematics, and his ideas were not taken up by any pupils.

The real foundation of a Russian school of mathematics dates only from the latter half of last century, beginning with the work of Chebychev. Russian mathematics began at once to develop on three separate lines: the theory of numbers; the theory of probability; and the theory of approximation, the latter owing its origin to Chebyshev himself. Following on the heels of Chebyshev came a whole generation of brilliant mathematicians, among whom were Zolotaryov, Korkin, Markov, Voronoy, Lyapunov, and Steklov, whose work was in the main on the theory of numbers, the theory of probability and analysis. It was thus a characteristic of the Russian school of mathematics that its members were engaged mainly on the solution of practical mathematical problems, and generalized theories were built up on the basis of the investigation of concrete problems.

This tradition of concreteness and at the same time great profundity of investigation dates back to the time of Lomonosov, and has marked most of the work of Russian scientific men. Their research work did not follow the lines of existing scientific knowledge, but broke new ground for itself.

Shortly before the Revolution in Russia, mathematics branched out in a new direction, basing itself on the work of French mathematicians and dealing with the more abstract theory of analysis. The founders of this school were Luzin and Yegorov, after whom came a number of their brilliant pupils.

Since the Revolution the development of mathematics has been particularly successful, and Russian mathematicians have taken their place in the front rank in diverse realms of mathematical science. The first place is occupied by the theory of numbers, which, thanks to the work of Chebyshev, Markov, Voronoy and others, had already reached a high level in Russia and to which has since been added original work by Delone, Chebotarev, Helfond Schnirelman, Vinkov, Vinogradov and others. Russian mathematicians now occupy a leading place so far as the theory of numbers is concerned. The investigations of Chebyshev, Markov and Lyapunov have played a leading part in the development of the theory of probability, and their work has been maintained by Russian science, thanks to the work of Bernstein, Kolmogorov and Hinchin.

The abstract side of Russian mathematics soon liberated itself from foreign dependence and reached a level such that the eyes of mathematicians abroad began to turn towards Moscow, thanks to work on abstract mathematics by Luzin, Suslin Uryson, P. Alexandrov and others. This side of mathematics began to develop on concrete and at the same time general problems in the newest branch of geometry, namely, topology, and on problems in algebra and analysis allied to it. New and important results in this field have been obtained by Pontyagin, P. Alexandrov, Kolmogorov and others.

The work of Russian mathematicians on analysis has many-sided characteristics. The qualitative theory of differential equations, which has numerous applications in astronomy, electricity, and so on, was dealt with before the Revolution in profound and original work by Lyapunov. This field has been taken up by N. Krylov, Bogolyubov and others. In the general theory of differential equations great progress was made before the Revolution, as is recorded in works of Steklov and Bernstein, and since by Alppo-Danilevsky as well as by Petrovsky and Sobolev.

The application of methods of mathematical analysis to problems in mechanics, the theory of elasticity and hydromechanics has given very important results, as can be seen in the work of A. Krylov, Muskhalishvili and Lavrientyev, the last-named having propounded an important general theory concerned with the functions of a complex variable. More recently, a young Soviet scientific worker, A. Alexandrov, by the application of new methods, has produced important new geometrical results.

We cannot in this short article describe in anything like detail the many and varied achievements of Russian mathematics during the twenty-five years which have elapsed since the October Revolution. We propose to deal here only with some examples of pure mathematical investigation in algebra and geometry.

Algebra, which may be defined as the science of the abstract study of operations in addition and subtraction, can be carried out not only with numbers but also with vectors, oscillations in alternating current circuits, etc. Every combination the elements of which can be subjected to the operations of addition and subtraction is called a cumulative group. From this it can be seen that the study of cumulative groups is of extreme importance. The problem requiring solution was the explanation of the properties of continuous cumulative groups and a method of investigating them. This problem was first solved by the Russian scientific worker, L. S. Pontyagin, with the aid of a method which he originated and which has since been successfully applied to other branches of mathematics.

Geometry is the science of figures, and although many geometrical problems are subject to visual proof, their solution is nevertheless often very difficult. In 1916, the well-known mathematician, Weil, propounded a fundamental problem of convex surfaces which he himself could not solve in its entirety. In 1940, A. Alexandrov showed that Weil's problem could be solved as a special case, and developed a new general method in the theory of surface areas. The fundamental part of the results obtained by Alexandrov is his discovery of a theorem of polygons which, though simple to formulate, is far from simple to prove. This theorem makes it possible to build up a convex polygon from pieces of paper cut to certain shapes. It may seem strange that what is at first sight an interesting problem for a child should be the basis of profound geometrical theories. Even such a problem, however, offers the greatest difficulty in solution.

Apart from purely theoretical investigations, Russian mathematics pays considerable attention to the solution of problems of an immediately practical character. Among problems of this nature we may point to research in the theory of the aeroplane, particularly by Christianovich and Keldysh, to work on rational laws of gunfire, on the movement of a shell, on the calculation of dams by Senkov's system, and other similar problems. At the present moment, when the U.S.S.R. is carrying on a great struggle against Fascism, these problems are of primary importance and occupy many of our leading mathematicians. It would be interesting to deal with these problems in greater detail, were it not for the fact that their significance in the present War compels us to keep them secret.

From this very short sketch, it can be seen that Soviet mathematics has attained a very high level. There are in the Soviet Union a number of outstanding mathematicians working in all realms of mathematics, and there is our own original school of mathematics, which, although it omits various branches, makes it certain that further development of the science of mathematics lies ahead in the U.S.S.R.

APPLICATIONS OF PHYSICS TO THE HEATING AND VENTILATION OF BUILDINGS*

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"The subjects of warming and ventilating, although in themselves simple, still deal with things and motions which are impalpable and invisible, and must be studied in their principles to be understood at all. Where the bodily eye can see nothing the mind's eye must note important processes. The peculiarity of the subject is proved by the fact of so many distinguished architects and engineers failing signally in undertakings to warm and ventilate."—Neil Arnott.

SO early as 1784, James Watt used steam for warming the room in which he commonly wrote, and his radiator, a box three and a half feet long, two and a half feet wide and one inch thick, was made of tin plates. The warming effect of this radiator, however, was less than he anticipated. The fact that Watt's expectations were not fulfilled serves as a reminder that engineering is, in a great measure, applied physics and that practical advances follow as and when progress is made in experimental physics. We now know that the radiator of 1784 did not emit sufficient heat because its surface was metallic, but it was not until 1801 that John Leslie discovered the nature and ascertained the properties of what is termed radiant heat.

Leslie found that the application of a coat of pigment to a metallic surface, instead of retarding the discharge of heat, nearly doubled it. He remarked that this fact, equally curious and important, was most contrary to the prevalent notions, and seemed not to have been hitherto observed. He showed that a tin canister, filled with hot water, cooled considerably faster after it was covered with flannel, and required the further addition of one or two

* From a lecture delivered before the Institute of Physics on November 17.