SCIENCE NEWS

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THE X-RAY MICROSCOPE

AN "X-ray microscope" invented by Professor W. L. Bragg, of the Cavendish Laboratory of the University of Cambridge, is the newest instrument for peering into the innermost structure of matter. By its means can be seen the actual arrangement of the atoms in one layer of the crystal.

The instrument is not yet fully perfected and at present applies to only one special case. But Professor Bragg hopes to extend its applications and believes that it will then be a useful aid in crystal analysis.

The X-ray analysis of crystal structure, which won the Nobel prize for Professor Bragg and his father, the late Sir William Bragg, is of immense importance in all branches of both war-time and peace-time industrial research. On the crystalline structure depends the strength of steel girders, the toughness of armor plate, the hardness of tool steel, the properties of aluminum alloys, the lubricating qualities of paraffins and of graphite, the stretching of rubber, the covering power of pigments; in fact, nearly every aspect of the behavior of a solid substance.

But X-rays passing through a crystal do not directly reveal its structure. They produce a "diffraction pattern" of complicated design from which the positions and spacings of the atoms must be calculated. This gives the arrangement in a particular plane. To get the true arrangement in space, several such patterns must be photographed by passing the rays through the crystal in different directions. A three-dimensional model can then be made. This is a long and laborious process.

Instead of making a drawing showing the arrangement in a particular plane, Professor Bragg's apparatus forms an optical image of it which can be viewed through an ordinary optical microscope. (The name "X-ray microscope" applies to the whole apparatus.)

He drills a number of small holes through a brass plate. The sizes and arrangement of these holes are determined by the diffraction pattern. The plate is placed in the path of a beam of ordinary parallel monochromatic light. This light in passing through the small holes produces a diffraction pattern of its own which, however, on account of the carefully calculated sizes and spacings, is a replica of the arrangement of the atoms in the crystal, each spot representing an atom. The image is focused and viewed through the microscope.

Thus, X-rays passing through a crystal are diffracted by the structures they encounter, but produce a pattern bearing no resemblance to this structure. By rediffracting this pattern backwards, so to speak, with ordinary light, Professor Bragg obtains a visible image of the atomic arrangement that produced it.

To get a good image, the holes in the plate must be accurately dimensioned and spaced to better than half a wave-length of the light used. On account of this difficulty, Professor Bragg has lately devised an improved method. An enlarged drawing is made in which the holes are represented by solid black circles. This is then photographed and reduced to the proper size, the black circles being in effect converted to transparent holes. The use of this in place of the brass plate gave much better definition.

The new method was reported to *Nature*, with photographs made with the "X-ray microscope," and drawings of the same crystal structure calculated from X-ray diffraction patterns, showing close correspondence between the two.

POSSIBLE AERONAUTICAL DEVELOPMENTS

THREE aeronautical developments would upset the present more or less new military aviation race throughout the world—a successful gas turbine engine for airplanes, a practical rocket plane and the realization of an airplane wing structure that would prevent the air becoming turbulent as it flows over it.

Dr. Jerome C. Hunsaker, of the Massachusetts Institute of Technology, aeronautical engineer and chairman of the government National Advisory Committee for Aeronautics, in speaking before the Harvard War Institute listed these as the three possible developments that might with some rapidity spring a surprise. It is known that engineers throughout the world have been working, attempting to achieve these objectives.

A gas turbine would be an escape from the very real task of lubricating ordinary internal combustion engines at very high temperatures, now a limit to efficient operation. Present engines waste a third of the gasoline's power in heat. Successful gas turbines operating on waste gases from diesel engines and the oil refining process have been perfected and are in use in Switzerland and in this country. The gas turbine in the airplane would eliminate the cooling system and also allow operation at 10,000 to 12,000 revolutions per minute instead of the 3,000 of the present engines.

Rocket planes avoid all engines and propellers, the propulsion being given by the kick of the rush of the gases out of an orifice at the rear of the plane. The Italians have already flown a small rocket plane from Milan to Rome. Rocket propulsion would be particularly effective in the high altitudes where the air is rare because the rocket kick doesn't need air to operate.

Making air flow smoothly over an airplane wing so as to maintain its untroubled characteristics might reduce the resistance or drag offered by the airplane by half. This is a major problem that might make a big difference in the performance of airplanes in the future if it could be solved.—WATSON DAVIS.

THE NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL

BY January, 1943, a new force of 172,000 young men and women will be ready to tackle the technical problems of war for Government and war industries. Already they are streaming from colleges, universities and technical schools as a result of speed-ups in educational programs.

This is shown in a count just completed of college students being trained for 103 war-vital occupations as picked by the National Roster of Scientific and Specialized Personnel. The survey was conducted by the American Council of Education at the special request of the National Resources Planning Board.

A majority of the 812 institutions surveyed are already teaching a capacity load of students in the fields where manpower shortages are developing, was indicated by Dr. C. S. Marsh, vice-president, in his report of the survey. Courses are being compacted, vacations shortened and the three-term college year is being substituted for the time-honored semester system.

Graduation comes at least a month earlier than it used to in the majority of the institutions studied. One technological school is delivering to industry twice its usual number of trained youth, and is doing it in sixteen months less time.

Seasonal peaks are also being ironed out of the college-trained manpower supply by changes in teaching policy and speed-ups of courses. Although June is still the favorite month for cap-and-gown processions and the awarding of degrees, there is now a steadier flow throughout the whole year. This is the tempo at which 1942's graduates will become available for war employment:

Already graduated in February or March, 12,000; in April or May, 43,000; June or July, 74,000; August or September, 13,000; December or January, 1943, 29,000.

Special courses have been organized by colleges to aid in the war program. Many have night classes in the ESMDT (engineering, science, and management defense training) courses administered by the U. S. Office of Education. Others have turned over dormitories and classrooms for use of Army and Navy fliers. Laboratories have been turned over to the Government for military research and faculty members have been loaned.

Special courses bearing on war problems, such as camouflage, explosives, tactics, map-making, radio communication, cryptography and military law have been organized.

The colleges and universities are facing a manpower problem of their own, meantime. Skilled scientists are being taken from teaching jobs to carry on military research. Enrollments of students are dropping off, too, but this does not balance the loss of faculty members. The professors most needed in war research are those teaching in the physical sciences. Their loss is not balanced by the drop in numbers of music students. Student enrollments have decreased most sharply in the liberal arts courses, teacher training and law schools.—MARJORIE VAN DE WATER.

ITEMS

MEDICAL students who have completed advanced Reserve Officers' Training Corps courses will have a chance to complete their medical course before being called to active duty, according to the War Department. If they have been accepted as matriculants in an approved medical school, they will be commissioned second lieutenants in the U. S. Army and placed on deferred duty status. They will be commissioned in the arm or service in which the training was received rather than in the Medical Administrative Corps. Those who have completed all requirements for the commission before entering medical school except the practical training at the appropriate service school will be required to attend the service school if the date of their entrance into medical school permits. If it does not, they will be permitted to withdraw from their R.O.T.C. course contracts, will be commissioned as second lieutenants in the Medical Administrative Corps and will be placed on deferred duty status until their medical training has been completed or discontinued.

PINE, spruce and other conifer seedlings frequently fail to grow when transplanted into prairie soil. Cause for these losses has been traced to lack of a certain type of fungous growth on their roots, by A. L. McComb and J. E. Sass, of the Iowa State College. Seedling loss was particularly troublesome on new nursery sites, where seedlings of jack pine, Norway spruce and other conifer species produced weak, straggly growth, or died when only a few inches high. Roots of these seedlings were found to be uninfected with the fungal threads known as mycorrhiza, which are found in the root tissues of healthy trees. Botanists believe that these fungi aid the trees in absorbing food materials from the soil. The situation was remedied by inoculating the soil with surface litter from an older coniferous plantation, which contained the necessary fungi. Phosphorus seems to be the chief plant food material which the fungi enable the trees to absorb. Application of phosphate fertilizer without soil inoculation resulted in satisfactory growth, and the fungi appeared on fertilized seedlings.

PERISHABLE foods are now being made to refrigerate themselves on American cargo ships, using an ingenious plan made public by the United States Department of Agriculture. Lard, chilled to a zero temperature or lower, is the refrigerating agent. By lining the holds of ocean-going ships with insulating material, packing large containers of the refrigerated lard to form a floor and walls around perishable foodstuffs, placing more lard over the top, and adding a final cover of insulation, the shipment is kept safely cold until it reaches its destination in England or Russia. The system has been adopted to keep Axis submarines from stopping shipment of perishables to United Nations ports by systematically sinking refrigerator ships. It has the added advantage of saving space which refrigerating machinery would occupy.

USE of sound waves to improve sulfa drug treatment of wounds, infections and burns is announced by Dr. Leslie A. Chambers, Dr. T. N. Harris, Dr. Francis Schumann and Dr. L. Kraeer Ferguson, of Philadelphia, in the *Journal* of the American Medical Association. The sonic vibration is used to break up sulfathiazole crystals into microscopic bits which when suspended in water or salt solution gives a preparation with the consistency of thick cream. This preparation can be injected through fine gauge hypodermic needles, which is usually not possible with neutral suspensions of ordinary sulfa drug crystals because of their larger size and irregular shape. The microanalysis of sulfathiazole can get to work faster at their job of stopping germ invasion because they dissolve more rapidly and do not clump or cake.