CHEMISTRY-PHYSICS

Helium Debate Settled

Second sound, the velocity of heat transmission at a very low temperature, is a quality of helium. A rise in the transmission speed of the sound occurs near absolute zero.

See Front Cover

➤ AN international controversy about helium has just been settled by scientists at the National Bureau of Standards. This international controversy is on the behavior of helium at the low end of the temperature scale.

Dr. J. R. Pellam and R. B. Scott investigated the behavior of helium near absolute zero. At room temperature, helium, second lightest of all elements, is a gas. It changes from a gas to a liquid at only 4.2 degrees Centigrade above absolute zero.

Absolute zero is the coldest temperature possible, 459.6 degrees below zero on the Fahrenheit scale or 273.16 degrees below zero on the Centigrade scale. At this temperature random motion of atoms and molecules ceases. At normal room temperatures atoms and molecules dash about at high speeds. The higher the temperature, the more motion the molecules have.

For the first time, through the use of a temperature-sensitive device, Dr. Pellam and Mr. Scott have made scientific measurements of the velocity of heat transmission at temperatures within one and one-third degrees Centigrade above absolute zero. This quality is known as second sound.

This phenomenon occurs only, so far as is known, in helium at extremely low temperatures. It is the term applied to the almost magically rapid heat transfer of helium.

The controversy concerned whether there would be a rise or a fall in the speed of transmission of this second sound when the temperature was less than one and one-third degrees Centigrade above absolute zero.

At room temperature, heat is transmitted when the atoms and molecules hit each other in the random motion.

This process takes time. At temperatures near absolute zero, however, the process is almost instantaneous. The scientists found that there was a definite, very smooth rise in helium.

The heat is transmitted very quickly by means of a peculiar kind of wave motion. Because this motion is similar to that of sound waves, the process of heat transfer is called "second sound."

When the temperature rises more than two degrees above the very coldest obtainable, the phenomenon of second sound does not occur.

Indication of the very queer behavior of materials at the temperatures near absolute zero can be seen on this week's cover of the SCIENCE NEWS LETTER. A flask of liquid oxygen is placed between the two poles of a magnet. The liquid appears to defy the law of gravity; actually, it is attracted to the two magnetic poles, thus causing the U-shape.

The characteristics of helium below two degrees above absolute zero are so remarkable that scientists have given the element a special designation, helium II. This liquid behaves so unlike any other fluid known that it is often referred to as a fourth state of matter or as the quantum fluid.

This research with helium II is expected to result in a new method of producing extremely low temperatures. The atoms of the superfluid type of helium can be separated from the normal type of atom. This is done by passing the fluid through an opening less than 1/100,000 of an inch in diameter. Only the superfluid comes through, and it does so without taking any heat energy with it. Successive passages through the extremely fine opening would separate most of the superfluid, thus allowing lower and lower temperatures to be reached.

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ENGINEERING

Cold Rubber Is Superior To Natural in Tire Treads

➤ THE relatively new synthetic known as "cold rubber" is superior to natural rubber for tire treads, footwear and a great variety of mechanical goods, the American Chemical Society was recently told by Dr. W. B. Reynolds, Phillips Petroleum Company, Bartlesville, Okla.

Fifty-thousand-mile truck tires, 75,000-mile passenger car tires, and longer-wearing foam rubber furniture cushions are among a host of improved products promised by the development of cold rubber, he said. The use of synthetic rubber in tire carcasses is another matter. In large truck and bus tires it still is desirable to have at least 70% natural rubber in the carcass compounds.

Cold rubber is a synthetic similar to the standard kind known as GR-S, but it is produced at a temperature in the neighborhood of 32 degrees Fahrenheit, the freezing point of water. It is from this fact that it gets its name. It was first made commercially about two years ago. Production, however, had reached an annual rate of 150,000 long tons by the end of 1949.

Some limitations of cold rubber are given by C. C. Davis, Boston Woven Hose and Rubber Company, Cambridge, Mass., in a report to the American Chemical Society's CHEMICAL AND ENGINEERING NEWS.

Although cold rubber is admittedly a big improvement over the standard synthetic known as GR-S, "no synthetic rubber has yet been developed which has such merit that it is acceptable in place of natural rubber for general use," he states.

"There is no prospect of a general shift from natural rubber to synthetic rubber in the near future," Mr. Davis declares. "Except in a few applications, such as the wire industry, natural rubber will remain the preferable material. Cold rubber, at present the most prominent of the synthetics, not only is inferior in some respects, but its price is higher than that of natural rubber."

Mr. Davis emphasizes, however, that cold rubber "is only the forerunner of synthetic rubbers so much superior in quality to natural rubber that the latter may ultimately become an unimportant item in the rubber industry—unless, of course, the rubber producers make corresponding improvements in natural rubber."

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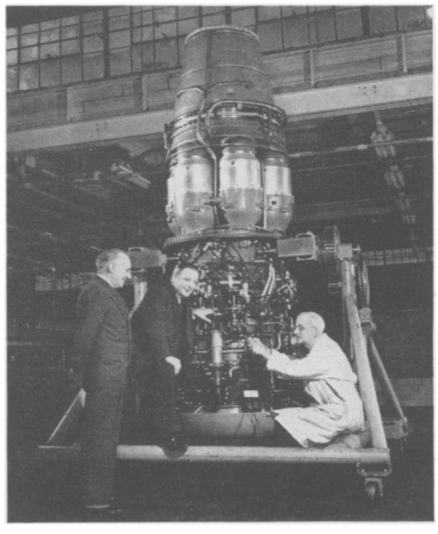

TURBOJET ENGINE—The Orenda engine will power the Avro-CF-100 fighter, first all-weather, long-range aircraft of its type, which made its maiden flight recently. Sir Roy Dobson, President of Avro Canada, (center) inspects the engine at the Malton, Ontario plant while Walter N. Deisher (left) and Leslie Foster (right) watch.