CRYOGENICS

Conquer Low Temperatures

Although absolute zero never can be reached, scientists have pushed the temperature to within 15 ten-thousandths of a degree above the lowest limit.

By ALLEN LONG

➤ EVEN IN all this summer heat, you probably shiver at the thought of such chilly temperatures as 20 degrees below zero. But to scientists who, with modern machines, have pushed the temperature within a fraction of absolute zero, a mere minus 20 degrees is hot.

Absolute zero, you may recall from your school days is the rock bottom of temperature scales. Bitter arctic weather may drop the thermometer to minus 70 degrees Fahrenheit. Absolute zero is about six and a half times colder, numerically speaking.

According to the classical definition, no heat remains at absolute zero. But actually scientists believe that some heat does exist at that temperature. Heat causes molecules of a substance to vibrate. The hotter the substance is, the more agitated its molecules become.

As a rule, when the molecules reach a certain degree of agitation, the substance melts. When they reach another degree, the substance shoots some of its molecules off, like steam evaporating from water.

Scientists have observed substances at extremely low temperatures. They now believe it quite likely that a substance's molecules would vibrate at absolute zero although, according to the classical definition, no molecular motion should exist.

Unobtainable Temperature

But scientists never will be able to demonstrate that the molecules are still in motion after a substance has been cooled to absolute zero. That is because a basic law of heat theory says the absolute temperature never can be reached.

With such devices as the Collins Helium Cryostat and powerful electromagnets, scientists can push the temperature almost to absolute zero, but the closer they come to their goal, the harder it is for them to go farther on down.

The Collins Helium Cryostat is one of the refrigerating machines that made very low temperatures available in many laboratories which could not afford former refrigerating equipment.

Named after its designer, Dr. Samuel C. Collins of the Massachusetts Institute of Technology, the machine will condense and chill helium to temperatures within one or two degrees Kelvin of absolute zero. In part it uses helium as "steam" to operate a piston-driven motor. The moving parts are oiled with gaseous helium because ordinary oil would freeze at those temperatures.

The Kelvin scale offers a convenient way to express temperatures. The zero of the Kelvin scale is absolute zero. On the Centigrade scale, however, the zero mark represents the point at which water freezes. On the Fahrenheit scale, zero represents the lowest temperature that Gabriel D. Fahrenheit could obtain by mixing sea-salt and ice.

Success in liquefying oxygen in 1877 provided the stimulus which drove scientists to seek the liquefaction of other gases such as nitrogen and hydrogen.

As time wore on, the atomic theory was proposed and scientists began wanting to reach low temperatures so they could study the behavior of matter in that unexplored area of physics.

At present, the record low temperature unofficially is held by Dr. Dirk DeKlerk, formerly of the Kamerlingh-Onnes Laboratory at the University of Leiden in Holland. He was assisted by Prof. C. J. Gorter and M. J. Steenland.

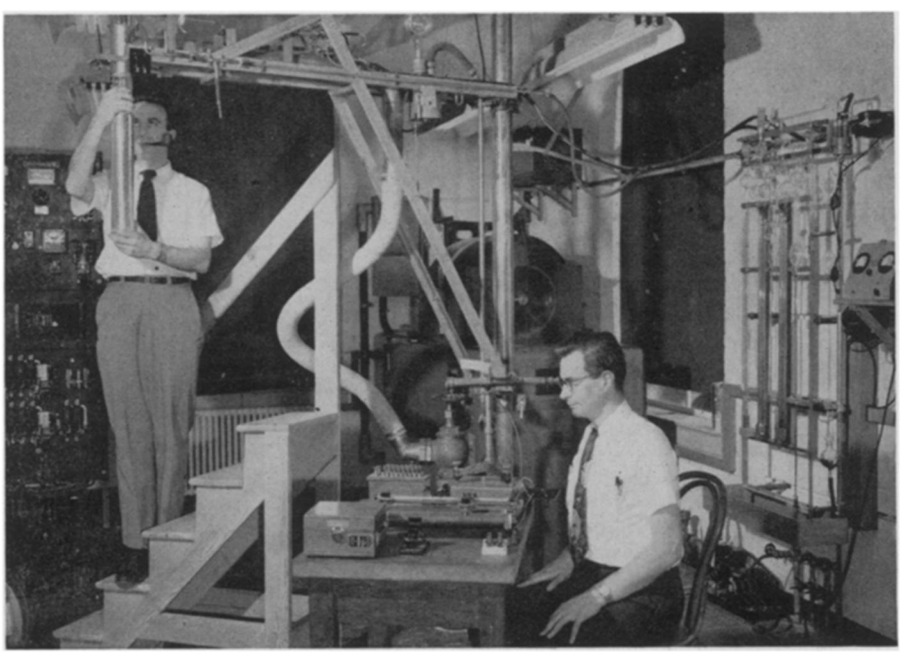
Dr. DeKlerk, now working in the cryogenics (low temperature) laboratories at the National Bureau of Standards, succeeded in reaching a temperature of only 15 ten-thousandths of a Kelvin degree.

He obtained that temperature by using adiabatic demagnetization, a process previously tried by other men. A paramagnetic salt was chilled by conventional supercooling processes until it was within a degree or so of absolute zero. Then it was placed in the field of a powerful electromagnet.

When the magnet was turned on, its strong field "established order in the molecules of the substance," he explained. That literally squeezed heat out of it.

After the heat had been carried away by the refrigerating system, the magnet was turned off and the low temperature had been reached. Dr. DeKlerk says some day the temperature probably will be pushed even lower.

Although the National Bureau of Standards low-temperature research workers would like to set an even lower record, at present that is not their goal. Currently they are searching for better ways to measure the extremely low temperatures, since mercury, alcohol and gas thermometers are unsatisfactory at those temperatures.



PLUNGING TEMPERATURES—Dr. R. P. Hudson makes a final adjustment of the liquid helium bath attached to the National Bureau of Standards' new "gallows." The apparatus, which contains a salt of chrome alum, will be swung into the field of an electromagnet for chilling to temperatures near absolute zero. Dr. D. DeKlerk prepares to measure the temperature of the substance.

The layman probably asks himself occasionally why scientists work so hard on something for which no immediate application is seen. The answer, of course, is that future undreamed-of applications may come along.

Some day rocket ships will be exposed to temperatures in the realm of absolute zero when they penetrate space. And if you are a passenger aboard that ship, you probably will be glad to know that the design engineers knew the rocket ship's metal body would work properly out there where it would be disastrous for something to go wrong.

Strange Reactions

As various substances were chilled to temperatures closer to absolute zero, they sometimes acted strangely. Helium gas became liquid at 4.2 degrees Kelvin, and it acted just like violently boiling water.

But when the temperature was lowered to 2.19 degrees Kelvin, a strange transfiguration came across the turbulent surface of the liquid. The surface became as smooth as glass. And then helium went haywire.

Defying gravity, it climbed up walls of the vessel holding it. It seeped through microscopic cracks in its container as if they were open doorways. If a test tube was thrust into it, the helium would climb into the test tube and fill it to a level equal to that in the container. If the test tube was removed, the helium climbed back out.

Scientists saw that was a new and distinct state of helium which had not been predicted. They called it "Helium II," and they called the turbulent, boiling liquid "Helium I." They called the strange gravity-defying flow of Helium II "superfluidity" because no apparent friction existed in the liquid.

Nor was helium the only substance that reacted strangely in the realm of absolute zero. Other materials astonished scientists by displaying some odd characteristics of their own.

When some metals were placed in liquid helium, an electric current induced in a closed ring of the frigid metal continued to flow for hours, even days, without stopping after the current source had been removed.

The apparent lack of electrical resistance violated all the rules for current flow at usual temperatures. Under normal conditions, current induced in a closed ring of metal stops almost instantly when the source is removed.

Scientists call that condition "superconductivity." They hope to find a practical use for it sometime in the future.

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PUBLIC HEALTH

Do's and Dont's for Polio

➤ IF POLIO, short for poliomyelitis, or infantile paralysis, is in your community, here are some do's and don'ts suggested by the National Foundation for Infantile Paralysis:

1. Do let the children continue to play and be with their usual companions. They have already been exposed to whatever polio virus may be in that group and may have developed immunity to it.

2. Do teach the children to scrub their hands before putting food in their mouths.

3. Do see that the children never use anybody else's towels, wash cloths, or dirty drinking glasses, dishes and tableware.

4. Do follow your doctor's advice about nose and throat operations, teeth extractions and inoculations during polio season.

5. Do watch for signs of polio, such as headache, fever, sore throat, upset stomach, tenderness and stiffness of back and neck.

6. Do call the doctor at once if such symptoms develop and put the patient to bed away from other members of the family.

7. Don't let the children mingle with strangers, especially in crowds, or go into homes outside their own circle. There are three different viruses that cause polio. Your children's group may be immune to one. Strangers carry another to which they are not immune. Being immune or having immunity means protection.

8. Don't let the children become tired or chilled. Overtired or chilled bodies are less able to fight off polio.

9. Don't take the children away from your home community without good cause. Polio time is the time to stay at home and keep with everyday companions.

If polio strikes your home, have confidence in your doctor. Call him early. The earlier the care, the better the chances for complete recovery. The child who gets polio has a better than even chance to recover without paralysis.

For more information or help, including financial help, get in touch with your local chapter of the National Foundation for Infantile Paralysis.

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MEDICINE

Zirconium Ointment Is Poison Ivy Remedy

➤ HERE IS good news for poison ivy victims: Now you can get the anti-poison ivy chemical, zirconium, in an ointment with the itch-relieving anti-histamine, Pyribenzamine. (See SNL, Aug. 25, 1951, p. 115.)

This combination, made by Ciba Pharmaceutical Products, is now on the market, and you will not need a prescription to get it from your drug store.

The zirconium in the ointment neutralizes the poison ivy poison, which is an oily material called urushiol.

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