The Temperature Man Best Enjoys

Engineering

Scientists Find What Heat and Humidity Make People Do

When mining engineers get together as they did at the annual meeting of the American Institute of Mining and Metallurgical Engineers, new and interesting facts are made public. In some of the 175 papers delivered at the scientific sessions, these achievements were recorded.

PEOPLE work best when the thermometer registers between 40 and 75 degrees Fahrenheit. A temperature greater than 90 degrees in moist, still atmosphere would soon become unbearable. A pulse rate of 160 beats per minute indicates that the limit of endurance of atmospheric conditions has been reached.

These facts are revealed by experiments conducted at the U. S. Bureau of Mines in Pittsburgh to find the conditions of temperature, humidity and ventilation at which man can live and work best. They were described by Dr. W. J. McConnell, of the Metropolitan Life Insurance Company's Industrial Health Service, before the recent meeting of the American Institute of Mining and Metallurgical Engineers held in New York City.

Although conducted primarily to find means of increasing the comfort and efficiency of mine workers, the experiments will have many other practical applications, Dr. McConnell said. "They enable the engineer to predict how human beings will respond to certain temperature conditions and to suggest the most efficient system of combating exigencies of environment," he declared.

The possibility of controlling atmospheric conditions to treat such pathological disorders as nephritis, rheumatic infections, other forms of arthritis, certain skin troubles, superficial infections, and a variety of respiratory infections was also told.

"According to these researches," said Dr. McConnell, "the maximum amount of work was performed by those tested between the effective temperature limits of 40 and 75 degrees Fahrenheit. Subjects of experiments were capable of performing four times more work in a temperature of 100 degrees with a relative humidity of 30 per cent. than in a saturated condition of 100 degrees. For ordinary humidity of 60 per cent., the subjects did about five times more work in a temperature of 90 degrees than in one of 120 degrees."

An upper limit of man's ability to compensate for atmospheric conditions has also been established. When at rest or in still air, it was explained, this upper limit lies around 90 degrees saturated, or an effective temperature of 90 degrees.

But if an air velocity of two and a quarter miles per hour is introduced, the other conditions remaining the same, the upper limit is raised to 95 degrees. With increased air velocity, a still further shift results.

When ordinary muscular work was done, measured as 90,000 foot-pounds per hour, this limit was reached at 80 degrees.

"The observations further indicate that the pulse rate rather than the rise in bodily temperature determines the extent of discomfort experienced," he declared. "When the pulse rate exceeded 135 pulsations per minute, the subjects complained of discomfort. They became restless and irritable and acquired a headache and palpitation of the heart. They became very thirsty; they noticed a metallic taste and spoke only with effort.

"The conditions became distressing and unbearable after the pulse rate exceeded 160 beats per minute. Dizziness and confusion resulted, followed frequently by nausea, and numbness or soreness of the face. As the severity increased a feeling of 'floating in the air' was experienced, and it is probable that heartstroke would supervene if the exposure were continued. When the subject left the test chamber, . . . the pulse rate began to drop rapidly and his condition immediately improved."

The tests were conducted in compartments insulated by cork board. Fans, heaters, humidifiers, refrigeration equipment, distributing system and automatic control could hold any dry bulb temperature from 20 to 180 degrees, humidity from 10 to 100 per cent. and velocity from still air to 1,000 feet per minute.

THE only active mine in South America producing emeralds, the world's most precious stone, is using today the crude methods of the Spanish Conquistadores as it did 400 years ago and is finding the ancient way of working entirely satisfactory and as efficient as modern machinery would be in the part of Colombia where the mine is located.

The revival of work in this mine, reputed to have yielded the Spanish crown an emerald so large that it was cut into a small cup, and the success an American company is now having there was described by P. W. Rainier of Guateque, Colombia, before the mining and metallurgical engineers.

Guateque is the nearest post office to the Chivor-Somondoco emerald mine. It is ten hours distant by horseback on bridle paths through dense forests. The average elevation at the mine, which is on the eastern slope of the Andes mountains, is 8,000 feet, and the land is so rugged that differences of elevation as great as 4,000 feet are often found within an area one and a half miles square.

Into this sparsely settled region so rugged and inaccessible, the cost of bringing modern machinery is prohibitive. With machinery skilled operatives would have to be imported, because the native Chibchas, dependable under firm control, do not have the capacity for learning to operate machinery.

But they can carry out well the simple mining operations of their ancestors, which are usually effective there because of the character of the land. "The forest growth on an area to be exploited is first cut down and burned," explained Mr. Rainier. "A trench is then dug to crosscut any veins that may lie below the surface, the loosened dirt being washed away by a head of water released from a tank above. . . .

"Occasional hard ledges of rock are hand-drilled and blasted. Apart from the drilling, the only tools used are crowbars and hoes. A recent crosscut section executed in this manner was 400 feet long, 120 feet deep, and involved the removal of approximately 200,000 cubic yards of material. . . .

"The emeralds are picked by hand

from the vein, graded, cleaned with acid and prepared for shipment."

Under penalty of law every person who killed a chicken in a certain section of Colombia, South America, had to submit the fowl to a government official for inspection. This was a recent, rigidly enforced statute, according to the report of C. Kendrick MacFadden, mining engineer of New York.

The jurisdiction of the law covered territory near the Muzo emerald mine during its recent operation by the Colombian government, explained Mr. MacFadden. The government did not want to lose any emeralds, and chickens much prefer them to ordinary gravel.

31 Miles Down

EXPLORATION of the interior of the earth 31 miles below its surface in Brittany, France, by measurement of an artificial electrical current passing through the ground was reported by Conrad and Marcel Schlumberger, of Paris.

While it is yet impossible to predict the formations at such a depth, the work of the Frenchmen is the first step in applying to such great depths a method which has proved itself of immense value to geologists in helping them locate valuable mineral deposits near the earth's surface.

The actual application of the electro-magnetic method to depths of 1,500 feet was reported by Theodor Zuschlag, consulting engineer, of New York City. Mr. Zuschlag described the Sundbery method which makes use of the magnetic field set up by a current passing through an insulated wire laid as a large rectangle on the ground.

In France the electrical potential method was used. A current of about two amperes was passed through the ground for a distance of 124 miles and careful readings of voltage and current taken. The current was limited by the different resistances of the underground formations.

Helium

ACCIDENTAL finding of a source of natural gas in southeastern Colorado said to contain seven per cent. of helium, the richest helium discovery ever made, was reported by F. F. Hintze, of the University of Utah.

Helium is usually found in natural gas only to the extent of one or two per cent.

"An open flow of 3,000,000 cubic feet per day was the estimated volume of the gas flow, and the helium content is said to be 210,000 cubic feet per day," elaborated Mr. Hintze. This does not mean that the well would yield 3,000,000 cubic feet of gas and 210,000 cubic feet of helium per day continuously. Its daily production would doubtless be less than a quarter of its open flow.

This discovery helps to clinch the hold of the United States on the world monopoly of the non-inflammable lifting gas for airships. The present price of helium is about $20 the thousand cubic feet, much higher than that of hydrogen, its inflammable competitor.

The discovery was made during oil drilling operations just south of Thatcher. The gas comes from a depth of about 900 feet.

The American Helium Company has located a small refining plant at Thatcher. The only other plants in the world for extracting helium from natural gas are at Dexter, Kansas, and Amarillo, Texas. The one at Dexter is another small plant of the private company while the large refinery the U. S. government established during the World War is located at Amarillo.

While the United States enjoys her monopoly, foreign nations are diligently searching for other sources of the valuable gas; and the British report success.

Monazite sand, source of thoria from which gas mantles are made, may provide the lifting power for future British airships. Work at the Chemical Research Laboratory at Teddington by R. Taylor has shown that this sand is a possible source of helium. Large quantities of monazite sand are available in the British Empire, especially Ceylon and Travancore, India.

The monazite sand yields about one cubic centimeter of helium to every gram of sand. This means that to fill a ship of 5,000,000 cubic feet capacity, the size of the R-100, newest of British dirigibles, 150,000 tons of sand would be needed.

The gas escapes from the sand on heating, so in treating it for the manufacture of thoria large quantities of helium are wasted. In the process for its refinement worked out by Mr. Taylor, the gas is treated with heated magnesium metal which removes most of the nitrogen, and then final treatment with heated calcium removes the rest of the nitrogen and other gaseous impurities.

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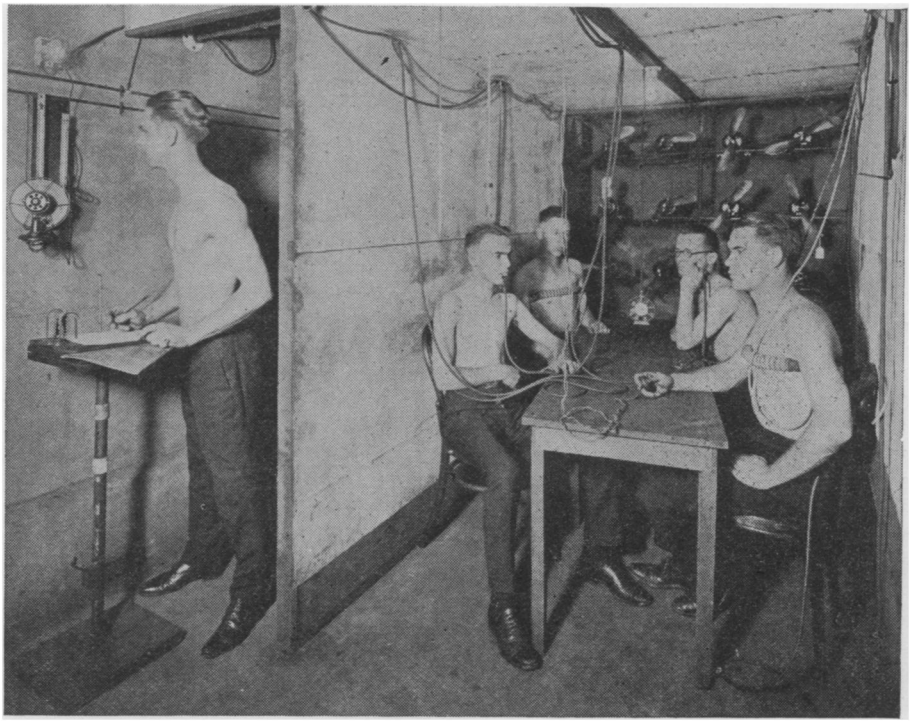

The test chamber, showing different kinds of scientific apparatus recording the behavior of human subjects under varying atmospheric conditions. Wet and dry bulb thermometers, respiration indicators, room thermometers, body thermocouples and fans for producing a constant artificial wind are prominent.