PHYSICS

Balloons Carrying Radios Tell Stratosphere Secrets

"Wobble" in Signal Frequency Indicates Altitude; Interruptions Tell of Temperature and Cosmic Rays

SMALL stratosphere balloons without pilots and using tiny radio transmitters to send back upper air information to earth-bound scientists will make possible a whole new program of cosmic ray studies, Dr. Arthur H. Compton of the University of Chicago reported in a statement to Science Service.

The small balloons—quite Lilliputian in size compared with the great 3,000,000 cubic foot bag of the recent National Geographic Society and U. S. Army Air Corps flight—weigh only 16 pounds when sent aloft by a bag whose largest extended diameter is but 15 feet.

The radio "voice" sending back the information to earth is a single tube oscillator transmitting a signal on twenty meters wavelength. A barometer, a thermometer and a cosmic ray meter affect the radio signal in such a way that accurate records of these conditions can be learned. A similar short wave oscillator is kept in continuous operation.

Changing conditions in a special barometer vary the frequency (or what is the same thing, the wavelength) of the transmitted wave. Air pressure, and hence altitude, is thus determined by recording the "wobble" in the incoming radio signal.

Interruptions Show Temperature

Temperature is recorded by vibrations of a balance wheel somewhat like that of a watch. Its period, or time of oscillation, is affected by the temperature. This mechanical oscillator interrupts the carrier wave at each vibration. Thus the radio signal comes on and goes off at intervals. The difference in length of the time intervals indicates temperature.

Cosmic ray intensities are determined by the current in the cosmic ray meter produced by ionization. The instrument is charged up to a known value. As the cosmic rays make the surrounding air electrically conducting, the charge of the instrument leaks away. How rapidly the leakage occurs depends on the intensity of the cosmic rays. Each complete discharge of the cosmic ray meter is noted by interruptions in the carrier radio wave.

All that is necessary in the ground laboratory, then, are instruments to make a record of the wavelength of the radio signal, telling the air pressure and hence the elevation; and to detect interruptions in the radio signal telling temperature and cosmic ray intensity.

Studies of the upper atmosphere, Dr. Compton stated, have been made before by the system of sending up automatic recording instruments on two small balloons of different sizes. Together the twin bags carry the apparatus aloft until finally the smaller one bursts.

The remaining balloon is insufficient in size to keep up the ascent, so that the apparatus descends gently to the ground. Reward notices are attached to the whole unit payable on the return of the apparatus. Good results have been obtained with this method, said Dr. Compton, by the German scientists Hess and Kolhorster and by Prof. R. A. Millikan in the United States.

While valuable, the method has one defect. It can be used only in regions of the world having a fairly dense population, where there is some assurance that the balloon and its instruments will be found and returned. Europe, the United States and southern Canada comprise the regions of usefulness of the method.

Expect Loss

Radio balloon apparatus, however, is sent up with little hope—and no need—of its recovery. The cost of $100 for each flight is only a few times that of an airplane flight and only a small fraction of the cost of a manned balloon ascension.

"We do not expect," concluded Dr. Compton, "that this radio transmission method of obtaining cosmic ray data from the stratosphere will replace measurements made in large balloons of the stratosphere type, because some

THROUGH THE GROVES OF THE SEA

The fisher on the glassy waters over coral groves must always be prepared for the strange and beautiful forms of life that may swim into his ken out of the next clump of animate bushes on the botttom. This little "herd" of marine game, photographed by Dr. W. H. Longley of the Carnegie Institution's marine biological station at Tortugas, is good to eat as well as pleasant to look upon. They are gray snappers, rated high among Florida food fishes.

kinds of measurements can only be made with equipment too heavy for small balloons to carry. Much information, however, can be obtained with these lighter balloons. This will supplement, in regions difficult of access, the more detailed information which the larger balloons give us in ordinary latitudes."

The region of the North Magnetic Pole, in the wilds of northern Canada, is expected to be one place where small radio balloons will be especially useful. The difficulties of transporting and launching a large manned balloon in the wilderness and the hazards which the balloonists would face on the landing exclude this method from any scientific program. The chances of recovering instruments by rewards would also be small, so that the radio type balloon seems to be the one solution to the problem in wild regions. Yet stratosphere measurements at the North Magnetic Pole would be among the most interesting of all. Ground measurements have been made at this point but upper air information is needed to supplement them.

Prof. J. M. Benade, Indian scientist from Forman Christian College at Lahore, India, developed the idea of using radio signals to transmit cosmic ray intensities, Dr. Compton said.

Science News Letter, September 1, 1934

CHEMISTRY

Citric, The Acid of Lemons, Found Now in Tobacco

CITRIC ACID, that makes lemons and grapefruit sour, is now being extracted from tobacco in Soviet Russia. Chemists have discovered that what, in part, makes poor tobacco bad for smoking is the presence of citric along with other acids like malic, oxalic and fumaric.

Using the citric acid from tobacco, Soviet chemists hope to free the U.S.S.R. from the necessity of importing this valuable chemical compound. Much of the citric acid which the U.S.S.R. buys each year comes from Italy, where it is extracted from lemons. In 1929 the Soviet Union had to purchase 142 tons of the acid from Italy alone, according to *Industrial and Engineering Chemistry.*

Prof. A. A. Shmook of the Soviet Tobacco Industry Institute has worked out a process for taking the citric acid out of the poorest varieties of Russian tobaccos. High-grade smoking tobacco contains very little acid and at times it is even absent altogether. In the cheap varieties the citric acid may be present in amounts up to 4 per cent., and even higher.

Equally Good Sources

Lemon juice, for comparison, is found to consist of about 3 per cent. citric acid and sometimes reaches 6 per cent. As sources of raw material for the production of the acid, lemons and tobacco are about equal. The U. S. S. R. raises much tobacco and few lemons. Hence the concentration on a way to obtain the acid from one of Russia's natural resources.

The manufacture of citric acid from fruits or plants containing sugar is not being neglected by the Russian chemists, however. One plant at Leningrad makes two tons of citric acid a year in this way, while another is under construction at Moscow which will have a production of eight tons.

Making citric acid from sugar-bearing substances is accomplished by adding a fungus growth to start fermentation. Citric acid has been produced all over the world in this fashion since 1896.

Two Stages

The process runs in two stages: the formation of a musty fungus film and allowing the fungi to turn sugar into citric acid. Five or six days is necessary for the method. At the end of fermentation the citric acid is separated from the messy solution by a method similar to that in which citric acid is taken direct from lemons.

Science News Letter, September 1, 1934

When preparing perishable foods, such as chicken salad, for a large gathering, says one health officer, it is wise to prepare small bowls kept chilled, rather than to work with one large bowl, since bacteria get a better start in life in the warmish contents of the big, slowly filled bowl.

ANIMAL PSYCHOLOGY

Dogs Recognize Words By Their Sound Alone

DOGS LEARN the meaning of certain words very well and are not fooled by similarly sounding words. Nor are they fooled by certain other circumstances purposely introduced to confuse them. These facts were brought out by extensive experiments made by Dr. Emanuel Sarris at the Institute for Environmental Research, at Hamburg, Germany.

Several dogs were used. They were given such names as Paris, Haris, Aris, Argos, Niki, etc., some of which have very similar sounds, others very different. The dogs learned to respond to their respective names perfectly. They were then taught a few simple words and phrases of importance in the dog world, such as meat, stick, basket, on the chair, under the table, etc. Once having learned these words and phrases, they recognized them under a variety of confusing circumstances by their sound alone, independent of tone of voice or emphasis, and without the help of signs or gestures. They recognized them when mixed with other words, when the speaker and object were out of sight, and whether the voice was male.

Word Order Not Cue

Thus, the dogs being in one room and the experimenter in another, such commands as the following were given: "Come, Paris, (or Haris, or Aris, etc.,) to the meat"; "Come to the meat, Paris," "Paris, come to the meat." In each case the appropriate dog did the appropriate thing. Variety of phraseology and similarity of sounds did not confuse.

Aris was sung to in Greek. In the midst of the poem, one of the words he knows was inserted, but it was sung in the same tone and rhythm as the rest of the poem. Aris recognized it at once and acted accordingly. Later he learned the Greek equivalent of the word.

Aris was taken into a room in the Institute where he had never been before. "On the chair," commanded his master, without moving a muscle. Aris ran all around the room searching and stopped finally at a chair turned over on its side. He looked at it dubiously for a few seconds, then jumped on top of it. In a similar way on different occasions he accepted a stool up-side-down, a stool on top of another, a bench, and a chair wrapped up in paper.

Science News Letter, September 1, 1934