Dr. A. F. Blakeslee and Dr. Sophia Satin, of the Carnegie Institution's Department of Genetics, examine their exhibit of work on bread-molds, proving that these lowly organisms show sex differences.

Three or Four Breaths a Minute

Physiology and Astronomy in Carnegie Exhibits

General Science

A PHYSIOLOGICAL celebrity, a young woman physiologist who breathes only three to five times a minute, was the object of great scientific interest and public curiosity during the Carnegie Institution of Washington's annual exhibition of scientific work.

The average adult breathes fifteen to eighteen times a minute, and the extremely slow normal breathing of the young woman, now an assistant in physiology in Goucher College, Baltimore, is considered by Dr. Francis G. Benedict, of the Carnegie Institution's Nutrition Laboratory at Boston, to be absolutely unique.

Not even ill patients in hospitals who exhale and inhale ten times a minute approach the usual rate of respiration of this physiologist who, while willing to aid science by studying the cause of her unique ability and demonstrating it to the public, desires to remain anonymous in printed reports.

Her unique rate of respiration was discovered about five years ago when as a student of physiology at Mt. Holyoke she noted that she did not breathe as fast as her fellow-students. The phenomenon came to the attention of Dr. Benedict, a leading research worker in the field of human physiology. He studied it and then traveled over Europe, lecturing to some 70,000 physicians in some 20 cities in an effort to find a similar case. A thorough search of the scientific literature was also made. No other instance of such slow breathing has ever been found.

Although her breathing is slow, the depth of the breathing is greater than normal. She inhales three pints of air at a time, whereas ordinary people take in and let out only one pint. Her lung capacity, however, is normal and not larger than that of the average person. The air passing through her lungs is normal in amount and the amount of oxygen she extracts from it is also normal.

If she were a singer, she would be able to hold her notes a phenomenally long time. Dr. Benedict has urged her to attempt singing as an experiment, but her interests lie in the field of scientific research rather than music.

If she were a sprinter, which she is not, she would probably be able to run 200 yards on a single breath, whereas the ordinary runner completes a hundred-yard dash in one intake of air.

In the demonstration, the young physiologist wears a special form of respiration mask, like an inverted bucket, which fits over the head. A rubber collar closes the open end, while a celluloid window permits her to see what is going on about her. Air enters through a tube at the top, and is sucked out through a tube at the side by means of a small electric blower. The exhaust air is drawn through chemicals to absorb the carbon dioxide breathed out of the lungs. After being thus purified, the air goes back to the mask and is breathed over again. A collapsible cylinder, like a city gas tank, goes up and down as the subject breathes out and in, while a pen attached to it writes a permanent record of the breathing volume on a revolving paper cylinder.

As the substance of the body burns to produce heat, oxygen is changed into carbon dioxide, and so the volume of air in the apparatus is gradually reduced. For every liter (approximately a quart) of oxygen that is used, about five calories, or heat units, are produced. Therefore, by measuring the rate at which oxygen is used up, the heat produced by the subject can be measured.

Astronomy and Movies

Partly because movie producers wanted a film that would give night effects to pictures taken in the daytime, Mt. Wilson Observatory astronomers have been able to prove conclusively the presence in the sun of carbon, most typical element of all living things, by spectrum photographs in infra-red light.

Speaking at the Carnegie Institution of Washington, Harold D. Babcock, of the Mt. Wilson Observatory, told of this and other phases of his researches into methods of taking photographs with light vibrating too slowly to be seen. This is called the infra-red region of the spectrum. Apparatus used in these studies was shown at the annual exhibition of the Institution in Washington.

When the white light of sunshine is broken up by the prisms of a spectroscope, it is spread out into the familiar colored spectrum, ranging from the shortest and most rapidly vibrating rays that make violet light to the

longer and more slowly vibrating red rays. Though not visible to the eye, the spectrum extends far beyond each end. Ordinary photographic plates record the ultraviolet or the region beyond the violet end, but are insensitive to even the visible red. Panchromatic plates are sensitive to red light, but not to a great deal of the infra-red, the still longer waves. These are the heat waves, and so it has been possible to study them by temperature effects. At best, however, this method is not as good as direct photography, and physicists and astronomers have sought a way of photographing these long waves. Many years ago Sir William Abney, an English experimenter, succeeded in photographing by very long infra-red rays, but his method was difficult and uncertain, and has not been used extensively since.

Neocyanin

The movie producers sought a way of photographing night scenes in the daytime, so as to avoid the use of powerful and expensive lights required for night photography out of doors. Photographs made by infra-red light give a black sky, and so they sought film to take movies by the infra-red part of sunlight. To meet this commercial need, explained Mr. Babcock, research chemists at the laboratories of the Eastman Kodak Company produced a new dye, neocyanin. Film or plates bathed in a solution of this dye acquire sensitivity to infra-red light.

Mr. Babcock also showed a photograph taken by these same plates in absolute darkness, to the eye. Using three bowl-type electric heaters, supplied with just enough current to heat their coils, without giving any visible red light whatever, he photographed some bottles and laboratory apparatus by infra-red light. An exposure of 48 hours was required.

All our knowlelge of the atoms that are in the sun and how they are put together comes from a study of the dark lines that appear in its spectrum photographs.

"The significance of lines in the spectrum lies in the fact that they announce the occurrence of definite changes of atomic energy," said Mr. Babcock. "The arrangement of lines in the spectra of the elements leads to a knowledge of the arrangement of the outer electrons of the atoms, of fundamental importance to the understanding of their physical and chemical relationships."

With the new plates, it is possible to extend this study far into the invisible infra-red part of the spectrum. Mr. Babcock has made photographs of the solar spectrum by light waves half again as long as the longest visible red waves. These waves are about twice as long as those of green light, and lie about twice as far beyond the end of the visible spectrum as those photographed by Sir William Abney.

One of the first results of this new method has been the definite proof of the presence of carbon in the sun. Previously only a few weak lines of this element have been photographed, but with the new plates one of the principal groups of the lines of carbon can be recorded. These are in the same position as carbon lines from a terrestrial source, and show conclusively that the sun, like our own bodies, contains carbon.

Making Radium Rays

Artificial radium rays, produced by 1,600,000 volts of electricity in special vacuum tubes, have now been achieved by the Institution's physicists. The tubes are really X-ray tubes, and by applying voltages of from one-half to several million, rays similar to the gamma rays of radium are emitted. The other kinds of radium rays, known as alpha and beta rays, can be produced by suitably modifying such a tube. With the aid of these rays, the Carnegie physicists are studying the heart of the atom.

The tube is composed of many separate X-ray tubes, with the rays feeding from one into the next. The entire battery of tubes is immersed in oil, while each one is individually shielded from the others. This makes possible smaller tubes and higher voltages than Dr. W. D. Coolidge, of the General Electric Co., used in a somewhat similar experiment.

Fossil Cats

Portraits of the giant cats that once roamed North America were a feature of the exhibition. Fossil finds at various places, but especially at the famous La Brea tar pits in California, have made possible the collection of an unusually complete series of skulls, representing all stages from kittenhood to snarling old age.

There are two definite types shown in the big-cat group of Ice Age time in America. One is the famous saber-tooth tiger, which used its exaggerated upper eyeteeth for killing its prey and fighting its enemies. The other is a more orthodox cat, a great lion, which has a skull and tooth arrangement more like those of the present-day lions and tigers.

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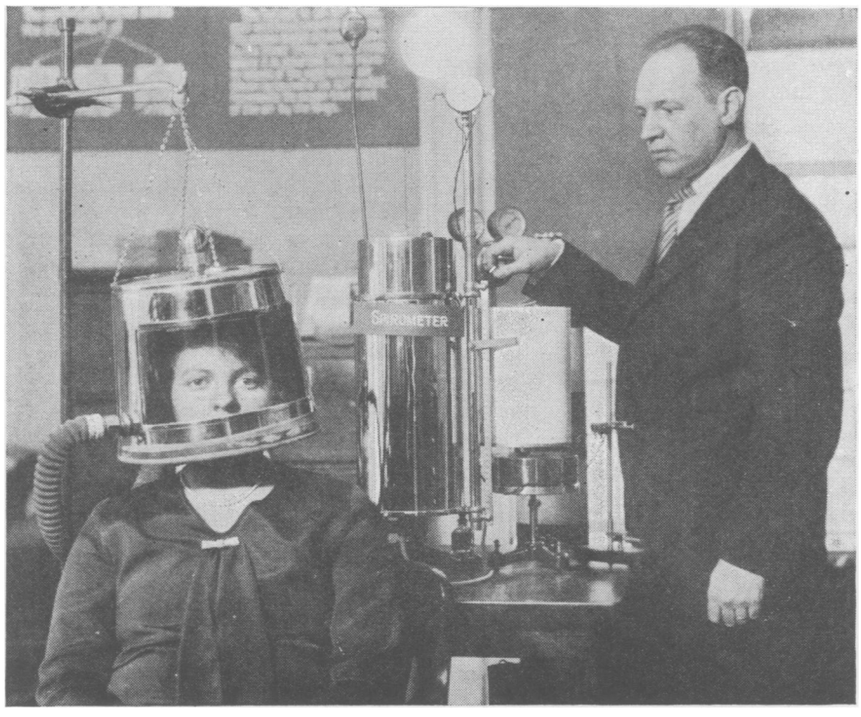

Dr. Edward L. Fox, of the Nutrition Laboratory, with the apparatus that measures breathing, testing the respiration of the young lady who breaths three to five times a minute.