to death in three or four weeks, even though they had plenty of wood to eat. Apparently they cannot digest their customary diet without the assistance of their colonies of protozoa. Dr. Cleveland suggests a method for taking advantage of this discovery torid a house of termites. "Close it up throughly," he says, "Cut off the termites' retreat through the basement to the ground. Fire the furnace to the limit, until you get a temperature of 95 degrees or higher. Keep it that way until you are sure the walls have been heated through for twenty-four hours. Or if you can get a temperature of 110 degrees or more, a much shorter period should suffice. With their protozoa dead, the termites should die of starvation in the midst of plenty."

More important, however, in Dr. Cleveland's opinion are the possible uses of his discovery in promoting health, through adaptations of his methods of killing protozoa with oxygen. He found that if pure oxygen were substituted for air at ordinary atmospheric pressure, or, what amounts to the same thing, if airk with its twenty per cent. content of oxygen, were supplied at five times the usual pressure, the protozoa in the bodies of termites and cockroaches could be killed in an hour or less, while the insects could stand the treatment for much longer periods - in some cases indefinitely. When pure oxygen was applied under pressure, the protozoa died even more quickly, and there was less risk to the host animals. Cold-blooded vertebrates, like frogs, also survived this treatment, but success has not yet been attained with warm-blooded animals. Dr. Cleveland is now contemplating further experiments on rats, in an endeavor to find and eliminate the causes of failture.

For more immediate results, however, Dr. Cleveland, in a second series of experiments on the warm-blooded animals, is searching for a chemical that will release oxygen to kill the internal protozoa without injuring the body tissues. He has had partial success with those he has already tried , and is now awaiting the arrival from Germany of a new compound which is claimed to be particularly efficient.

THE SUN AND OUR WEATHER

By Dr. Charles Greely Abbot,

Assistant Secretary, Smithsonian Institution

(Dr. Abbot keeps the closest watch on the sun of any man on earth. In this article, written for Science Service, he points out the immense practical possibilities that lie in knowing the exact effect of variations in the energy poured forth by the sun.)

There seems to be evidence to show that very moderate changes in the sun's heat, without much affecting the aveaage temperature of the world as a whole, may yet make the difference between prosperity and failure in some localities here on earth.

The studies of H. H. Clayton, an American meteorologist, show plainly that major changes of the barometer and temperature in the United States come from solar variations. About 10 years ago, Mr. Clayton, then chief forecaster for the Argentine Government, began a long thorough investigation of just exactly what happens to barometers, thermometers, and rain gauges all over the world when the sun's heat changes. By 1920, he was actually employing solar measurements of the Smithsonian Institution to make public official forecasts a week in advance for the

temperature and rainfall of Buenos Aires. These weekly forecasts are still maintained.

At first sight the matter is very simple You would all probably say that if the sun sends more heat the weather would grow warmer,if less heat, cooler. But the subject is more complex. A place tends to be warm or cold according as its prevailing winds come from tropical or polar directions. In the atmosphere there are regions of low barometer and regions of high barometer. Look on the weather map and you will see that in the United States the winds blow counter-clockwise all around the low centers, and clockwise all around the high centers. Meteorologists call these effects cyclones and anti-cyclones.

If now the system of cyclones and anti-cyclones is shifted north, south, east, or west by any cause, there will be a change of wind and consequently a change of temperature. Rainfall also is modified. According to Mr. Clayton's researches this is exactly what happens when the sun's heat changes. The barometric highs and lows move a few hundred miles, and alter the wind directions, and with them the weather.

Data for stations all over the world and for all seasons of many years must be compared with recorded solar changes before meteorologists will be in shape to begin predicting from the state of the sun's heat. This great work is only begun. That is why our Weather Bureau does not use these methods of forecasting.

The part of the Smithsonian Institution in this new movement is to secure regularly accurate measurements of changes in the sun's heat. We began to make these studies over 20 years ago in Washington, but soon found it necessary to move to clearer skies. We discovered that the sun's heat varies and afer years of research that took us to three continents we established in 1918 an observatory in the Nitrate Desert of Chile where it almost never rains and where there is neither animal, insect, reptile,nor vegetable life, and where all water and supplies must be hauled many miles. From this observatory nearly 10,000 feet above sea-level, and at another station on a mountain in Arizona, over a mile high, daily solar observations are made and daily telegraphic reports are sent to the Smithsonian Institution.

There is great difficulty in making observations accurate enough. The sun's changes seldom exceed 3 per cent. though sometimes reaching 5 per cent. or more Mr. Clayton's results indicate that solar changes as small as 1 per cent. or less are yet great enough to produce noticeable effects on the weather. It is only lately that we have succeeded in refining methods to this degree of accuracy. But for about two years past our two stations, which lie over 4,000 miles apart, have agreed together to about one half of one per cent. on the average of all good days, and have agreed in showing solar changes of from one to five per cent. For over two years they have indicated that the sun's heat has been generally from one to two per cent. below normal, but at present it is nearly up to normal again, and apparently seems marching towards higher values.

Between summer and winter, andbetween night and day, enormously greater changes than three or five per cent occur and we adjust ourselves to them. Why should we worry about such seemingly small changes in the sun's heat?

The answer is that the food plants, the great cities, and others of the most important things in the world are found exactly where they are because they are all adjusted to exactly the climatic conditions which prevail. And those adjustments are apparently very capricious. Why do palms grow in southern England,

which lies as far north as our bleak Labrador coast, for instance, and why do people winter in the south of France, as far north as Ottawa, while in America people go to Florida or southern California to get mild winters?

What I am driving at is that a little change in the quantity of solar heating might alter the distribution of heat over the earth in such a way as to produce perfectly astounding changes. One per cent change of the heat available to warm the air over the dnormous area of the tropics may be of little effect there but may easily produce very much larger effects towards the poles. For the areas of the zones grow less towards the poles. It is like the tides. On the open oceans they oscillate only a foot or two, but in the confind Bay of Fundy the tidal wave is over 40 feet high.

One looks forward to a time when daily telegrams shall come to a central station from at least four solar radiation observatories instead of from two as now and the condition of the sun shall be broadcasted for the use of meteorologists the world over. For, after all, the temperature and all life on the earth hangs on the sun's rays. They ought to be throughly investigated so that we may be informed in advance what we are to expect as the consequences of changes in the sun.

SUN SPOTS CONTROL ANIMAL POPULATIONS, SCIENTIST CLAIMS

Periodic increases in the numbers of certain animals are blamed on the sun and its spots by C. S. Elton, of the department of zoology and comparative anatomy of the University of Oxford. Extraordinary as this conclusion may seem, Mr. Elton offers scient fic data to show that animals populations are influenced by the well known sun spot cycle.

By methods of mathematical analysis it is possible to recognize definite climatic cycles, he says, even in a country with a variable climate. In seeking the causes of these variations it is reasonable to look to the sun, the source of practically all our energy. For over 150 years records have been kept of the number of sun spots. These increase to a maximum about every eleven years. Increase in the number of sun spots is accompanied by an increased output of energy by the sun, and, strange to say, by a low temperature on the earth. Further, the average annual temperature of the whole earth, the atmospheric pressures and rainfalls of various parts of the earth, the tracks of storms in North America and the rate of growth of the redwood tree, have all been found to show marked eleven-year fluctuations which correspond to those of sun spot numbers. There are natural records in the case of the redwood dating back in many cases three or four thousand years.

Turning now to variations in the numbers of animals, if the return of rabbit skins taken by the Hudson Bay Company be consulted, the interesting fact is established that the numbers increase to a maximum every eleven years, and that each maximumcorresponds to a sun spot minimum. The fur returns of this company, which have beer kept since 1845, give a good index of the total rabbit population; hence the conclusion is reached that variation in the number of sun spots in some way affects the rateof reproduction of rabbits.

Biologists cannot yet explain this extraordinary relationship, but it seems