Just for fun . . .

ADDENDUM

In gran'pa's day!

Nature Magazine Vol. 29 No. 1 January 1937

PREHISTORIC WEATHER

By CHARLES FITZHUGH TALMAN

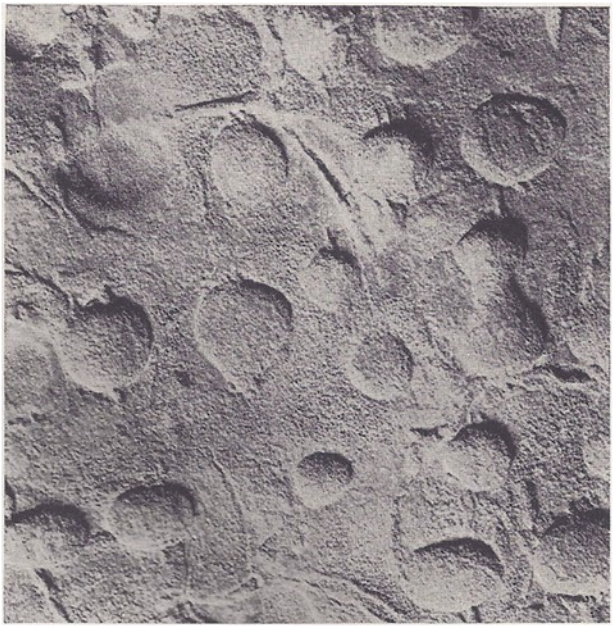
A few years ago members of Admiral Byrd's last Antarctic expedition climbed a glacier less than 300 miles from the South Pole. In the rocks at its summit they found a deposit of coal. Previous expeditions had discovered coal at other places in Antarctica, and it now appears that the coalfields of that ice-bound continent may be among the largest in the world. The fact is of interest on account of its economic and political bearings, but also for another reason.

The coal fossils brought back by explorers reveal a picture of the climate conditions that prevailed in the Antarctic at the time the coal-making plants flourished there; supposedly around 250,000,000 years ago. The climate was mild, humid and windy. On the wind-swept hills plants were rather scarce. In the valleys there was a luxuriant swamp vegetation of ferns and trees.

Geological evidence also tells us something about Antarctic climates at other remote epochs. There were long periods when the land was a cold desert, though not ice-covered. There were others when it was a warm desert. Great glaciers appear to have formed for the first time about 60,000,000 years ago.

The weather of the past is gone beyond recall. Unlike the pottery of ancient cities and the remains of extinct plants and animals, it cannot be dug out of the ground; yet in a multitude of ways it has left records of its activities, and the interpretation of these records is one of the fascinating tasks of modern science.

Many fossils besides those of the coal measures indicate the atmospheric conditions to which the once living organisms were adapted. Thick layers of ripple-marked silt, buried deep in the earth, show the places where great rivers once flowed through regions now waterless. Sun-cracks in these layers tell of hot summers. Coral limestones found in old geologic strata must have formed in warm seas. Annual rings in fossil tree-trunks mean that the trees grew where winter cold alternated with summer warmth, rather than in a climate with little seasonal variation of temperature such as now prevails in the tropics. Boulders are mementoes of the huge migrating glaciers that scattered them far and wide over the land.



PHOTOGRAPH BY U. S. GEOLOGICAL SURVEY

THE RECORD OF A PREHISTORIC RAINSTORM

Raindrops that fell millions of years ago left their impressions in this Utah limestone. The form of these cavities indicates the force and direction of the accompanying wind

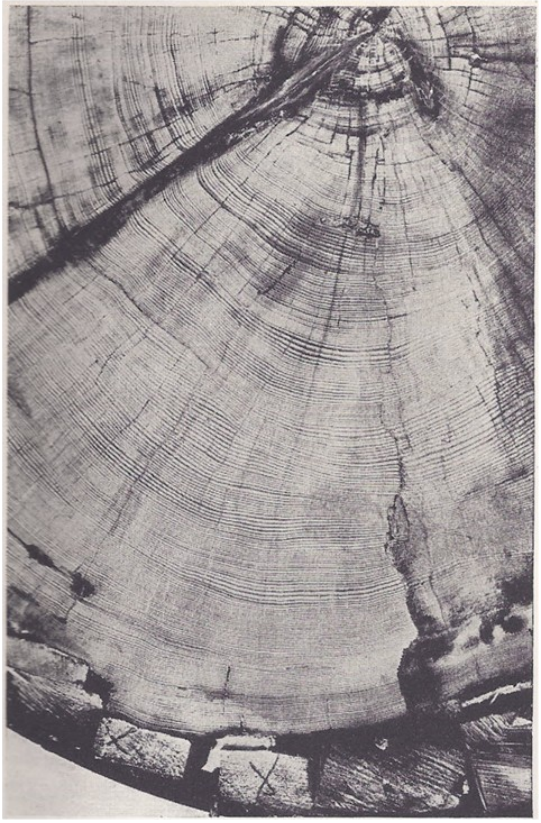
Deposits of salt and gypsum found beneath the soil are the products of former desert climates in lands now fertile.

Records of rainstorms that occurred millions of years ago are found today in the shape of the small round marks known as "rain-prints" or "fossil raindrops." There is no mystery about the formation of these marks, for the process is still going on and can easily be observed. A sea beach, for example, may often be seen after a shower to be pitted with the little depressions made by the drops. If the wind blows from the land, these pits are likely to be filled with dry drifting sand. If a square of this material is carefully cut out and baked hard, we obtain impressions of a durable character.

The rain-prints collected by geologists throw a certain amount of light upon the weather and climate of the past. Their age can be determined approximately from the accompanying fossils and other characteristics of the formations in which they occur. Thus

COAL AGE VEGETATION

Vast coal fields recently discovered in the Antarctic are proof that the South Pole basked in warm sunshine 250,000,000 years ago. At this period landscapes much like the one here pictured must have prevailed. Photograph from a painting by W. Kukuk in the Geological Museum, Bochum, Germany



PHOTOGRAPH BY DR. E.. DE KIRBY

A NNUAL RINGS IN A FOSSILTREE TRUNK

This spruce tree, which probably grew more than 100,000 years ago, was laid bare by the retreat of a glacier in British Columbia. As in trees of modern growth, the varying thickness of the rings indicates periods of rain and drought

their prevalence gives some indication of the relative raininess of different geological periods in particular regions, and the character of the rainfall. Their forms likewise indicate the direction and force of the winds accompanying the primeval shower. If the wind blew from the south, the southern side of the depressions will slope downwards gradually toward the north, while the opposite slope will be more or less precipitous. The greater the contrast between the steepness of the opposite slopes, the stronger must have been the wind. Symmetrical depressions were formed in calm weather. A good many years ago the geologist Baron de Geer discovered in Sweden remarkable yearly weather records rocks that were once the clay beds of lakes fed by the summer melting of glaciers during the declining stage of the last Ice Age; and similar discoveries have since been made in other parts of the world. The glacial streams carried much sediment into these lakes. Coarse sediment sank quickly to the bottom, but fine sediment remained for a long time in suspension, finally settling down after the flow of the streams had ceased with the oncoming of winter. The rocks resulting from this process are banded with alternate layers of coarse-grained and fine-grained material; the former light in color, the latter dark. Each pair, representing a year's deposit, is called a "varve." Because more ice melted and more sediment was deposited in hot summers than in cool, some varves are much thicker than others, and these differences give us an interesting record of yearly variations of temperature for certain portions of the earth and for particular periods of the remote past.

An entirely different sort of varve recently has been discovered. It consists of two very thin layers; a darker one composed of organic material and a lighter one of mineral material. Varves of this kind are supposed to have been formed, not by the melting of ice, but by deposits of sediment in lakes and seas containing an abundance of minute organisms. The remains of these tiny living creatures deposited at a particular season of each year-probably when their mortality was greatest on account of the cooling of the water-are believed to have formed the dark layers. As the amount of living matter in the water varied with temperature, the layers are supposed to indicate by their relative thickness variations of temperature from year to year, just as do the glacial varves. The biggest known deposit of "nonglacial" varves, as these layers may be called, is the one found by Dr. W. M. Bradley in parts of Wyoming, Utah and Colorado that were once covered by a vast inland sea, The deposit is 2,000 feet thick and furnishes yearly weather records extending over many millions of years.

In many parts of the temperate zone, lakes left in the wake of the retreating Ice Age glaciers were gradually filled with accumulations of plant material and thus converted into bogs. In these bogs are found some interesting records of the climatic variations that have occurred in their vicinity during the past ten thousand years and more, Most of the mucky substance below the surface of the bogs is decayed beyond recognition, but

PROOF OF A FORGOTTEN DROUGHT
Goose Lake, California, was laid bare by a drought in the summer of 1926, and on the lake beds were found these wagon tracks probably made by a pioneer of the 1840's, indicating that an unrecorded drought must have prevailed at that time. Photograph from the Yellowstone Cut-Off Association

myriads of tiny pollen grains that were blown into the lakes at various times from surrounding vegetation are so well preserved that the species to which each belongs can be identified under the microscope.

With the aid of a special boring tool, samples are taken from different depths in a bog. Examination of the pollen found in these specimens shows the types of vegetation that grew from age to age in the vicinity, and each type of vegetation implies the prevalence of a certain type of climate at the time of its growth. Predominance of northern pines, for example, indicates a cool dry climate; spruce and fir point to a cool and humid one. Hardwoods grew when rainfall was abundant; grasses replaced trees when rain was scanty. The rate at which a bog formed can be roughly estimated, and thus approximate dates can be assigned to the periods when the different kinds of climate prevailed.

There have been several Ice Ages when enormous glaciers spread over the continents from centers in high latitudes. Each is supposed to have included relatively cold and mild spells--called "glacial" and "interglacial" periods, during which the ice blankets alternately advanced and retreated. These variations imply that the main wind belts and storm tracks shifted widely, and that climatic conditions everywhere varied greatly.

The annual rings of growth seen in cross sections of tree trunks vary in thickness more or less closely with the weather prevailing at the time of their formation. In some parts of the world the thickness of the rings depends mainly upon rainfall; a thick ring denotes a wet year and a thin ring a dry one, as has been proved by comparing rings of recent growth with actual measurements made with rain-gauges in the vicinity.

More than half a million rings in about five thousand specimens of wood have been measured by Prof. A. E. Douglass and his assistants in the southwestern United States, and they give us for that part of America a record of rainfall variations extending back more than twelve centuries. One of its interesting revelations is that a great drought, surpassing in intensity any that has occurred on our continent in historic times, prevailed in this region from 1276 to 1299 A. D., and there is evidence that it caused a general exodus of the Indians then living in the region affected. The next most protracted drought registered by the trees lasted from 1573 to 1593.

In fossil trees, some of which grew many millions of years ago, the rings show similar variations and thus furnish clues to the vicissitudes of ancient weather.

Beginning in the Middle Ages there are records of other kinds from which we can get some idea of climatic conditions and of the variations of weather from year to year. We know, for example, the dates during long periods of time when certain rivers and harbors were frozen over in autumn and were opened in spring. There are also recorded the dates year by year when certain crops were sown and harvested in various European countries, including records of wine harvests in France back of the year 1400. Variations in lake levels have been recorded in some regions. Those of the Caspian Sea furnish an index of rainfall covering more than a thousand years.

Explorations on the sites of former settlements afford evidence as to the climatic conditions under which the inhabitants lived. Such evidence, as well as that drawn from history, is, however, easily misinterpreted, and both have been the basis of fallacious beliefs concerning radical climatic changes. The commonest mistake has been to assume a progressive diminution of rainfall in regions where agriculture once flourished but is now unpractical. In many such cases the present inability to grow crops is due to the fact that the fertile soil has been washed away (a process that is even now ruining many agricultural lands) or has been buried under windborne sand from deserts. In other cases, a scanty rainfall was formerly eked out by irrigation, but the irrigation works have fallen into decay as a result of political catastrophes or racial deterioration.

Nearly everywhere in the world we hear the popular assertion that "the climate has changed." So it has, though not so rapidly as the man in the street supposes. The big changes occupied probably millions of years; the smaller ones lesser periods. Yet grandfather will probably tell you it was colder when he was a boy.

A THIRTEENTH CENTURY DROUGHT RECORDED IN WOOD

This charred beam found in Indian ruins in Arizona reveals the weather conditions from the year 1276 to 1316. Note the thinness of the annual rings from 1276 to 1299, indicating stunted growth of the tree scanty rainfall. From 1300 to 1316 rain must have been plentiful, as the rings are considerably wider. The tree grew as much in the ten years from 1300 to 1310 as it had in the 24 years from 1276 through 1299.