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PALEOBOTANY

## How the Redwoods Marched Around the Pacific

By FRANK THONE

Trees march.

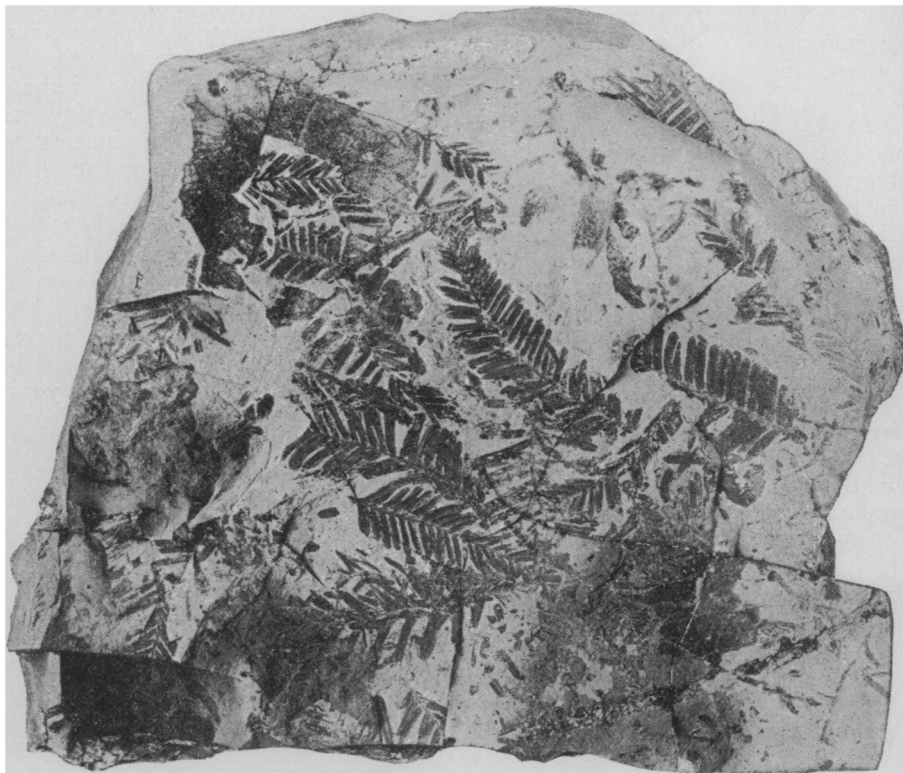
Deeply though their roots are anchored, far down into the soil and through crevices in the solid rock, forests move like armies.

Not mere little afternoon jaunts, either, like the famous hike that Shakespeare wrote about, when Birnam Wood came to Dunsinane Hill. They cross whole continents, and if an ocean gets in their way they simply go around it.

A new chapter in the history of forest migrations has recently been written by Dr. Ralph W. Chaney, research associate of the Carnegie Institution of Washington. In the same parts of Asia where the expeditions of the American Museum of Natural History found their famed dinosaur eggs, he has found the stone-writ record of the trees and bushes through which these mighty beasts once went crashing. And strange to say, though the dinosaurs have long since vanished, and whole generations of other monsters have come and gone since them, the forests that grow in northern California today are so much like those Manchurian forests of millions of years ago that only an expert professional botanist could tell them apart.

It was in the cold, arid, inland region of the Gobi in Mongolia that the drama of the dinosaurs centered. The high point in the studious adventures of Dr. Chaney was reached in the kinder climate of Manchuria, to the east of Mongolia, and separated from the latter province by a high range of mountains, the Khingan. Here, associated with the great Manchurian coal deposits, some of which are already being mined, he found the fossil tracks of the march of the redwood forest.

The record was plain and easy to read. It was, indeed, in the form of a great stone book, with layers



*A PAGE FROM THE ANABASIS OF THE REDWOODS, more ancient than the Age of Ice. The darker patches are fragments of fossil alder leaves*

of shale for the pages, imprinted with the fossils themselves as the words. A veritable picture-writing, and a thousand times clearer, at that, than the man-made hieroglyphics of Egypt or early China.

"Here were the redwoods!" That was the record written largest on page after page, through stone volumes representing hundreds of millennia. "Here also were alder, oak, maple, ferns," the record continued. But these latter species were not written in so often. There were fewer of their fossil leaves and stems and fruits pressed out between the pages of shale. The inference was easy enough. The more there were of a given kind of fossil, the greater must have been the orig-

inal mass of vegetation that bore that kind of leaf. Therefore we had here in Manchuria, two million years ago, a forest consisting predominantly of redwood trees, with maples and alders among their huge trunks, and oaks fringing the forest. The ground, at least along the stream courses and perhaps elsewhere also, was carpeted with ferns. If you go into the forest in the famous "redwood belt" of the coast of northern California you will find exactly such a picture. And you will find it nowhere else on earth!

There are other writings on the multiplex pages of the ancient stone books which Dr. Chaney has read—

corollary notes to his chapter on

*(Just turn the page)*

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## The March of the Redwoods

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the march of the redwoods. For instance, there is a living species of hawthorn in northern China and Japan that has leaves like those of a long-extinct fossil species found in Oregon, and there is no living American hawthorn that shows a like relationship. One of the common elms now growing in northern China is much like a fossil elm from eastern Oregon which has no near relative, either living or fossil, in America.

But to return to our redwoods. What was their line of march? Did they originate in the Old World and cross over to the New by way of the Bering Straits region, as the human race is assumed to have done? Or did they evolve first in America and "go west" until they reached Asia? A final answer can not be reached on the basis of the data at present in hand, and Dr. Chaney very wisely refrains from offering one. If we look at a map showing the places where redwood fossils have been found, we see most of the spots on the North American continent. But that may mean nothing more than that North America has been more thoroughly combed over for fossils than the vast empty spaces of interior Asia. More Asiatic expeditions and more intensive work in other fields are needed before a conclusion can be reached in this absorbing problem.

There is a hint, on the distribution map of the finds of redwood fossils, of a possible third alternative. You will see these finds spotted in away up in the Arctic: in Spitzbergen, on the west coast of Greenland, out on the waste tundras of northern Canada, and one find far up among those desolate islands north of Baffin Land where Peary used to go when he turned his face toward the then unconquered Pole. Geologists have good evidence that these icy lands once had temperate climates, with at

times even subtropic conditions. May it not be that the nursery of the redwoods was in a lost polar paradise, now buried under the groaning glaciers of Greenland, or perhaps even sunk beneath the Arctic sea?

But that question, fascinating as it is, must remain unanswered for the present.

Dr. Chaney has found other things written in his ancient books of stone, in these same picture-words made by falling leaves and twigs. The record gives to him who can read some idea of the climate enjoyed by the Manchuria of two million years ago. The redwoods whose fossils he has found there were like the California coast redwoods, rather than the "big trees" of the more inland mountains. The present California coastal forest enjoys an equable climate, virtually without freezing temperatures, a rather humid atmosphere, and a rainfall of from forty to fifty inches, distributed fairly evenly throughout the year. This is a much milder climate than Manchuria has had during historic times, and probably than it has had since the Pleistocene, or glacial period. Manchuria's climate resembles that of our own Middle West; cold winters, rather hot summers, a rainfall considerably less than that of the present redwood belt of California, and not so evenly distributed. The country supports a rich growth of oaks, elms, maples and other trees, but nothing resembling the redwood forests.

It is not necessary to infer, however, that in the milder-climate days when the redwoods grew there the weather was exactly like that of modern northern California. Dr. Chaney points out that redwoods grow in the northern United States when transplanted, and that these ancient trees might have been willing to get along with a somewhat less humid climate. But there can be little doubt

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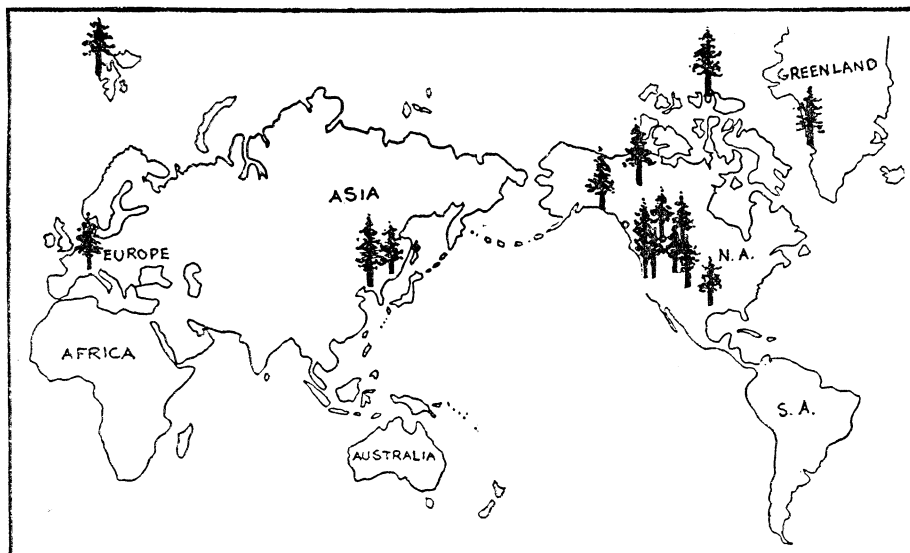
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THE TREES on this map mark the places where fossil remains of redwood have been found; they are stations on the long trek of the trees. Note especially the spots in the Arctic regions, where the tallest trees now are dwarf willows barely four inches high

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that when the Manchurian coal beds were being formed this ancient Asiatic land was at least a little more California-like than it is now.

As an interesting experiment, which will have to wait some years, perhaps even several centuries, for a complete answer, Dr. Chaney has planted near Peking and also in the Altai mountains a quantity of seeds of both the coast and the "big tree" species of the redwood. We may see the beginnings of the answer, our great-grandchildren will note further progress therein; no one knows how remote the human generation that will witness the death of these trees. As everyone knows, some of the "big trees" are older than Christendom.

More inwardly in Asia, in the same region where the dinosaur remains were found, Dr. Chaney has found other stone books with other botanical and climatological records. The lofty Khyngan mountains, which separate Manchuria from Mongolia, drain the sea winds of their moisture, just as the high Sierras and Cascades drain the Pacific winds, making the great contrast between the moist coast lands and the arid inter-mountain plateau region. The contrast between present-day Manchuria and Mongolia is quite as marked, and the contrast during dinosaur days must have been even greater. For Dr. Chaney has been unable to find that the Gobi region has ever supported a rich forest of the Manchurian redwood type, or indeed any extensive forests at all.

During the Cretaceous period, which was the time of the dinosaurs, the

(Just turn the page)

### CHEMISTRY—AGRICULTURE To Aid Cornstalk Use

Hungary, the country that unwittingly sent the corn borer to threaten the corn crop, America's greatest agricultural industry, is now making amends in the person of Dr. Bela Dorner, the chemist who has shown how to extract from cornstalks millions of dollars' worth of cellulose, the basic raw material for paper, rayon, lacquers and other products. Dr. Dorner is now in this country cooperating with the Cornstalk Products Company who are about to go into quantity production at their plant in Danville, Ill.

In a statement to Science Service, Dr. Dorner expressed his pleasure over the reception accorded him in America, and spoke in enthusiastic terms over the prospects for turning the millions of tons of hitherto wasted cornstalks into sources of income for farmers and factory operators.

"The industrial hunger for cellulose is world-wide," he said. "It is even more pronounced in Europe than in America, but industrialists everywhere recognize that with new uses for cellulose appearing daily, new and cheaper sources must be developed."

Although he worked out his process in Europe, Dr. Dorner was thinking mainly about America as the place where it will have its highest development.

"In Europe we do not regard cornstalks as the waste which you consider them in the great Corn Belt of the United States," he said. "Although Hungary is the fourth

country of the world in corn production, being in fact the Corn Belt of Europe, peasant farmers and small land owners use their stalks for fodder, and only on the large estates in some of the corn-growing provinces is there a surplus. In recent years the Hungarian government has compelled all stalks to be consumed or burned by April 1 to comply with corn-borer regulations.

"I am sorry to learn that this pest is spreading rapidly over the United States and that similar regulations must eventually be enforced probably in all corn-growing areas of your country. I am painfully aware that America traces this pest to an importation from Hungary; wherefore I am doubly proud of bringing to your agriculture and industry a Hungarian process for utilizing the cornstalks and making their destruction profitable. Cornstalk cellulose factories will be a boon to farmers wherever they are established.

"It is gratifying to learn that there is no unkindly feeling toward my country because we unintentionally sent you the corn-borer. We similarly recall in Hungary that the phylloxera pest which ravages our vineyards came from America, but we pray that you may not send us your Prohibition as the antidote!"

Dr. Dorner is one of the foremost industrial and agricultural chemists of Hungary. He has been connected continuously with the government service, in which he is completing his twenty-fifth year. The position he now occupies is equivalent to the directorship of the Bureau of Standards in this country, combined with that of chief of the Bureau of Chemistry in the Department of Agriculture.

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### HYGIENE

### Watercress Has Vitamines

The list of foods the doctor says you should eat has been augmented by a new one, watercress.

This familiar garnish for meat and salad is a remarkably rich source of the vitamin necessary for growth and of the scurvy-preventing vitamin C, Dr. Katherine H. Coward and P. Eggleton of the University of London have found. It boasts of small quantities of vitamin D as well.

The green shows considerable seasonal variation, however, in its growth promoting properties, being more effective in this respect in spring and summer than in winter.

Science News-Letter, February 18, 1928

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### The March of the Redwoods

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dominant trees were Araucarias, modern forms of which are known in cultivation as Norfolk Island pine, monkey-puzzle tree, and by other names. They are now native only to lands in the southern hemisphere, especially South America. The living Araucaria species all prefer cool, rather dry habitats, and independent geological evidence connected with the dinosaurs indicates that the Mongolian species of these great lizards were dry-land, cool-climate animals. Thus we have two lines of evidence that the Gobi of two million years ago was more or less like the Gobi of today—not so dry perhaps, but certainly not a moist country, and subject to a rather cool climate.

Other fossils of a later date, the Tertiary, when the dinosaurs had vanished from the earth, show that the Gobi was still sticking to much the same kind of climate. At present there are no trees at all in the Gobi proper, but in the canyons of the Altai mountains, which extend out into it, there are numerous cottonwoods and shrubby junipers. These living trees, growing under conditions of low rainfall which make life possible for most trees, may be supposed to reflect the environment in Mongolia during the Tertiary, a suggestion which is amply supported by the associated fossil animals. These are almost entirely of plains types, including none of the forest animals which should be preserved in the rocks had there been widespread forests in Mongolia during that period.

Thus far have the pages of the great stone books of Manchuria and Mongolia been opened by the scientist. They still await further reading, and as soon as the revolutionary difficulties in China shall have run their course, scholarly adventurers will again be hard at their lessons, turning the pages over with pick and shovel.

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In the days of Hamurabi, 4,000 years ago, perfumery was considered so essential that even servants were ordered to use it.

The striped bass, which was carried from its home in the Atlantic to Pacific waters in 1879, is now the second most popular game fish in northern California.

Trees standing in Yellowstone National Park that turned to stone over 4,000,000 years ago were recently identified as sequoia, sycamore, and chestnut varieties.