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FOREVER IN AMBER
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EXPLORER: More than 300 years ago, Sir Francis Bacon spoke of amber as "a more than royal tomb" for tiny insects. Twentieth century scientists may quite agre

ANNOUNCER: The University of California welcomes you to its one thousand,five hundred 61st broadcast with the University Explorer. In a story called "Forever i Amber", he tells how nature has preserved in plastic a fascinating picture of ancient life. Here is Hale Sparks, the University Explorer.

EXPLORER: To most of us, I imagine, a fungus gnat is a transient and insignificant creature. But the little winged insect we have our eye on now is about to achieve for himself a sort of immortality. The scene is a pine forest. The time, about 30,000,000 years ago. The place, somewhere in that part of the prehistoric world which is known to us now as the State of Chiapas, in Mexico. This gnat we're talking about is attracted by a fragrant sticky substance exuding from a tiny hole in the bark of a tree, a hole made by a wood boring beetle. As soon as the gnat alights on the yellowish tree-sap, he's done for, his life is ended. The resinous substance, like flypaper, entraps him and his struggles to free himself are futile. It's not long before other drops of resin accumulate, entombing the insect in a globule of tree-sap. This globule, in time, falls to the ground; and, because of its relative lightness, is carried off by rainwaters to a stream. From the stream it gets to a river, and thence to the edge of the sea where it sinks at last to the bottom of a quiet lagoon. The transparent lump containing the perfectly preserved fungus gnat is slowly covered by alluvial deposits. Then ages pass. Geologic stresses and strains uplift the strata and landslides occur. Objects long buried are exposed to the light of the sun and to the eyes of man.

One day an Indian, searching for amber, finds the yellowish, encrusted lump, along with other specimens, and takes it back to his village. There he fashion a string of beads for his wife. Among the beads on that string is one which has embedded within it like a delicate trinket our tiny fungus gnat. The beads are passed on through many generations until at last they are inherited by a young Indian girl in the village of Santa Lucia. Into that settlement one day come two North American scientists looking for amber to use in their studies. They ask for news of recent landslides and other places where amber might be found. Before they leave the villag they bargain for, and finally buy, the string of beads worn by the Indian girl.

Not long ago, I talked with one of the scientists who passed through the village of Santa Lucia on a search for insects in amber. He is Dr. Paul Hurd, Jr., assistant entomologist on the Berkeley campus of the University of California. Dr. Hurd was looking for just such fossil inclusions as that represented by the fungus gnat of the prehistoric Mexican forest. Recently, there have been many discoveries of insect-bearing amber in the State of Chiapas, discoveries made possible by the Associates in Tropical Biogeography of the University of California. These finds, Dr. Hurd told me, are closely related to similar finds in other parts of the world; and they're filled with the romance of past and present Central American peoples.

Like the Romans and Egyptians, the Mayan Indians of Central America used amber for purposes of adornment, worship, barter and burial. By means of amber alone it has been possible to trace the routes of ancient traders from the Baltic Sea near

Samland, where huge quantities of amber were found, to the eastern Mediterranean. Many specimens of fashioned Baltic amber have been discovered, for example, among the burial effects of the great pyramids of Egypt. And in Central America limited studies involving amber have shown that there, too, the mineral may help to reconstruct ancient history.

But the entomologist's main concern, of course, is with the world of insects. Among all the living creatures on earth they are the most abundant, the most varied and the most highly specialized; and I learned from Dr. Hurd that the story of Central American insects of some 20 to 30 million years ago is at our very fingertips These insects, which were so remarkably preserved in the fossilized tree gums of the prehistoric forests, are now clearly visible to us in amber. They often appear to be virtually alive.

There's sometimes much work to be done, however, before the entombed bug is ready for examination. Raw amber collected in the field may be heavily encrusted with other material, such as fossilized oyster shells and rock, and this has to be cleared away in the laboratory. As a matter of fact, the entomologist seldom knows just what kind of insect he's going to find, if any, beneath the crust. By careful scraping, and then polishing the exterior surface to let in the light, he's able to examine the brittle lump for signs of fossil inclusion. If something proves to be there, he may saw off a section so that the fossil is more clearly exposed. Once this is done, the fossil is placed in mineral oil to increase the clarity of the embedded specimen. In many cases, this process is so successful it's like looking at a contemporary insect; for even the original colors are still evident, after millions of years.

Sometimes a great number of insects are packed so closely together in one piece of amber that cutting is made virtually impossible. I was shown one polished half-inch cube, for example, that included five stingless bees along with several minute flies and parasitic wasps.

As each piece of raw amber is scraped and polished to reveal a fossil insect, it's possible to glimpse into past millenniums of time. The examination of every piece is a strange and thrilling experience for the entomologist, Dr. Hurd told me. Not only do scientists gather specimens of insects just as they were some 30 million years ago, but when these specimens are studied in the aggregate, an amazing story begins to unfold. The insect types already found cover a wide range. And as each additional field collection of raw amber or newly acquired string of amber beads is examined, new types are discovered which help to fill in the picture of prehistoric life.

Apart from insects, one of the most common things found suspended in amber is pollen. By studying this fossilized plant dust scientists may be able to learn what kind of vegetation existed in the forests of prehistoric Mexico. With further research they'll someday tell us exactly what the climate in that area was like millions of years ago, and so contribute to the study of any science which happens to concern itself with that kind of environment. We can also learn much about the movement of flora and fauna since early times. Many of the plants and bugs caught in the tree gums of the ancient forest no longer live in the region today, but the types they represent are found elsewhere. And, on the basis of fossil study, we're able to check the history of certain insect habit patterns. For example, a study of stingless bees found entrapped in Mexican amber shows us that the "social habit" among bees is at least 30,000,000 years old. The habit that ants have of keeping other insects as "guests" is at least that old, too; for ants together with their guests were caught in the exuding tree sap and preserved through the ages.

The richest tomb of ancient insects yet discovered is Baltic amber found in a region of Germany called Samland. Most of us are already familiar with Baltic

amber; it's commonly cut into small ornaments and beads, which used to be worn as necklaces by superstitious ladies to ward off discomforts of hay fever, asthma and other allergic ailments. Such beads, like those of the Mexican Indian girl, often contain small insects.

Baltic amber is the fossilized resin of an extinct species of pine that grew in the Baltic region during the geological period known as the Oligocene, some 70 million years ago. Insects were caught in much the same manner as they were in prehistoric Mexico. Pieces of crude amber that are now found on the shores of the Baltic vary greatly in size; some weigh a pound or more, but most are very much smaller. Fortunately the pieces are often accumulated in earth pockets, where they can easily be dug out.

Insects preserved in amber are not in every sense of the word complete. There's nothing, of course, to stop the decay of their internal organs. But all their external details, even to the most minute bristles and hairs, are faithfully preserved, due to the fact that their outer covering is made of a tough, horny material called chitin -- a word coming from the Greek for "coast of mail". When we look at one of these specimens, what we actually see is its mold in the amber, lined with a pigment made up of material from the chitinous skeleton. Any attempt to free the fossil insect by melting away the amber is doomed to failure. For, once the supporting material has been removed, the specimen crumbles into dustlike fragments. Hence, we have to study it just as it lies in its amber tomb.

What does this tomb itself really look like? Well, clear amber is a transparent material of a yellowish or brownish color. Usually, however, the amber is clouded with trapped mold, vegetable matter, tiny air globules, and bubbles of water vapor exuded from the insects. This may block our view of the specimens, but as Dr. Hurd pointed out, they can often be saved for study by careful cutting and polishing of the amber into small squares or slabs.

As far as we're able to tell, insects first came into existence on this planet about 250 million years ago. Their evolution coincides roughly with that of the air-breathing back-boned creatures. Among the earliest creatures were some winged forms very different from any bugs now living. But there were also some hardy fellows, such as the cockroaches, that still exist in much the same form in the warmer parts of the globe. The evolution of insects moved rapidly toward great variety and specialization. By the dawn of the Age of Mammals, which we think was about 75,000,000 years ago, insects were around in number and variety closely comparable with the earth's insect population today.

While scientists have been able to study specimens of amber found in the Baltic for many years, they're just beginning to see the story of ancient insect life as revealed by the recent Mexican discoveries. In 1954 the University of California asked a resident of Mexico to investigate a region in the State of Chiapas for signs of amber deposits. A year later, after two surveys had been made, the University decided to send its own investigators on an amber hunting expedition; and Dr. Hurd, along with his colleague, Dr. J. Wyatt Durham, professor of paleontology, set out for Chiapas.

The State of Chiapas is a very mountainous country in the southern part of Mexico, bordering on Guatemala. Its mountains are steep-sided and there's not much soil on the slopes. At certain times of the year tremendous rainfalls loosen the soil, causing huge landslides. These slides, Dr. Hurd told me, are just what the fossil hunter is seeking, for it's in such places that amber bearing strata are likely to be exposed. Mexican amber, like that of the Baltic, is found in the so-called "blue earth", strata which actually bear that color and are in texture like good hard shale. Before each expedition begins, and often during an expedition, the amber

hunters gather information as to the whereabouts of four or five recent landslides. Then it's likely to be a matter of trekking across beautiful but difficult terrain by mule and canoe until the particular site is reached. Upon arrival at a site, the hunters begin the sometimes painful search for specimens. They have no Geiger counters, or other detection devices, to guide their steps. For them, it's a problem of prodding, digging, scraping and hammering.

When amber is first found, it is often firmly embedded in rock. It may be surrounded by some matrix material, such as fossil oysters. At other times, minute pieces of amber are scattered about. On occasion, a hammer-blow will crack off a shell of rock to reveal the familiar yellow glint, as the fractured amber reflects the sunlight.

Every piece of amber that's found is deposited in the geological sampling bag. Full information is taken concerning associated fossils, the surrounding fossilized plant and marine material, so that the specimens can be dated by the paleontologist. Then the whole collection is shipped back to the laboratory where the exciting search for insects in amber begins.

Descendants of the little fungus gnat I described being entrapped in the tree gums of an ancient forest may be struggling even now in the sap of some modern pine. The process continues today, just as it has in the past. Sometimes, Dr. Hurd told me, it's possible to watch a fallen lump of tree gum, with its insect inclusions, being washed down a river on its way to the ocean sediments. There it may ultimately become fossilized within the developing strata. Perhaps scientists of the distant future will study it to learn the story of insect life in our era.

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