Reports

Parasitic Conifer Found in New Caledonia

Abstract. A rare and unusual species of *Podocarpus* from New Caledonia was collected and discovered to be parasitic on another conifer. The attachment is by modified roots imbedded between the cork cambium and the vascular cambium. A parasitic gymnosperm is something new to science.

The interesting species, *Podocarpus ustus*, has always occupied a unique position in its genus and family, and among conifers in general. It grows in remote, densely forested highland parts of New Caledonia. It has rarely been collected and has probably never been studied in the field by any competent scientist. The closest to field study was achieved by J. B. Hair of New Zealand, who succeeded in having fresh specimens brought to a field laboratory where he was making chromosome determinations. Its uniqueness has derived from the fleshy deep red or purple scale-leaved branches that have the uncooperative habit of disintegrating into minute fragments when preservation is attempted. *Podocarpus ustus* is the single member of the section *microcarpus* of the over-sized genus *Podocarpus*. In reproductive structure it is a reasonably typical member of the family Podocarpaceae.

Because of the special interest which *P. ustus* has aroused, a special effort was made during a December 1957 visit to New Caledonia to collect the elusive plant. One of its areas of occurrence was visited, and several plants were seen. This report derives from the fact that one of these plants was growing out of the base of a tree of *Dacrydium taxoides*. As might be suspected from the fleshy red nature of *P. ustus*, it is a parasite, certainly sometimes, probably always. The parasitic specimen was collected and has been the subject of a careful study.

Podocarpus ustus is a woody shrub. In the case of its attachment to *D. taxoides*, the largest of two emerging stems had a diameter of about ½ inch and the host had a diameter of about 3 inches. The parasitic stem curves sharply so that the root zone is oriented upward. Most of the woody roots travel up the trunk of the host, probably for several feet; a few grow downward for several inches. The modified roots are imbedded in the bark between the cork cambium and the vascular cambium. General stimulation of the vascular cambium has occurred, producing a thickening in both wood and bark tissue. The cambium of the slightly anastomosing roots, significantly, is on the outside toward the cork cambium. No normal phloem is produced, although a tissue full of sclerids opposite the xylem may represent modified phloem tissue. Around the parasitic roots, the host tissue is somewhat disorganized and forms a sheath of abnormally large cells.

In several ways the specimen of *P. ustus* reported here is not typical. No other specimen has been seen growing from the trunk of another plant. Typically *P. ustus* grows on the open forest floor under rather shady conditions (chlorophyll is present in the leaves). Probably most individuals are root parasites. Several attempts by foresters in New Caledonia to dig up small specimens for transplanting resulted in immediate death of the specimens. It was noticed that removing the specimens involved cutting out various tree roots, but, because a parasitic attachment was not expected, it was not looked for. Although *D. taxoides* is closely related to *P. ustus*, it may not be the preferred host. *Dacrydium taxoides* is common throughout the highlands of New Caledonia, and the rareness of *P. ustus* might seem puzzling. Lumbermen say that the densest stands of this peculiar species occur in association with an undetermined plant which, by its description, may belong to the Cupressaceae. Thus the preferred host of *P. ustus* may possibly be a rare and perhaps unnamed conifer.

It must be remembered that *P. ustus* is not necessarily always parasitic. The possibility of root grafting, a common phenomenon among conifers, may explain the entanglement of roots that has been observed. However, the single specimen upon which this report is based shows unmistakable parasitic modifications. There is no fusion of tissues as in grafting. The xylem strands run through the host phloem. These modified root strands do not show radial symmetry, but do show polarity with respect to the host. That parasitism may well be normal in this species, then, is inferred from the definite modifications that have been made for parasitic attachment, together with the general habit of this species which strongly resembles that of known root parasites. In the observed specimen, a seed has lodged against a trunk instead of over a root.

Until now, all conifers were known to be independent trees, bushes, or trailing shrubs. *Podocarpus ustus*, in being parasitic, thus differs from all other conifers. In fact no gymnosperm of any kind has previously been discovered in a parasitic relationship to other plants.

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Instructions for preparing reports. Begin the report with an abstract of from 45 to 55 words. The abstract should *not* repeat phrases employed in the title. It should work with the title to give the reader a summary of the results presented in the report proper.

Type manuscripts double-spaced and submit one ribbon copy and one carbon copy.

Limit the report proper to the equivalent of 1200 words. This space includes that occupied by illustrative material as well as by the references and notes.

Limit illustrative material to *one* 2-column figure (that is, a figure whose width equals two columns of text) or to *one* 2-column table or to *two* 1-column illustrations, which may consist of two figures or two tables or one of each.

For further details see "Suggestions to Contributors" [*Science* 125, 16 (1957)].

Origin of Tektites

Barnes, Kopal, and Urey (*1*) have recently criticized the idea originally advanced by Nininger (*2*) and later discussed by Gold, Varsavsky, and me (*3*), that tektites originated as secondary bodies from the infall of meteorites on the moon.

The principal criticism of Nininger's hypothesis was one stated earlier by Urey (*4*), who argued that the tektites could not have arrived at the vicinity of the earth as a swarm, since a swarm of the necessary size and density would be gravitationally unstable at the earth's distance from the sun. Urey considered that the tektites could not have arrived as a compact mass, since this mass would be distributed over an area a few tens of kilometers in diameter, while the australite fall covers an area thousands of kilometers in diameter.

If, however, we admit the possibility that the tektites fell from nearly circular orbits around the earth, as suggested by O'Keefe (*3*) and La Paz (*5*), then this difficulty largely disappears. The tektites were conceived as spiraling into the earth's upper atmosphere in a compact, gravitationally stable mass, which was broken up by differential drag during the last few orbits before the tektites fell. The fall would thus closely resemble the phenomena of the meteor procession of 9 February 1913, for which Chant (*6*) and others postulated a nearly circular satellite orbit around the earth. Breakup of the larger bodies of this shower was directly observed.

A nearly circular satellite orbit will have one or two sections, which might be called "active regions," from which meteorite falls are likely to occur. If the orbital eccentricity is greater than the earth's ellipticity (about 0.003), the body will approach the earth most closely at perigee. If the orbit is very nearly circular, the closest approach will be at the nodes, because of the equatorial bulge.

At any instant, the falls from the active region will occur along an arc of a great circle, where the orbit reaches its lowest point in the atmosphere. In the case of the 1913 shower, this seems to have been the region from about Port Huron, Mich., to Wilkes-Barre, Pa., according to the work of Chant (*6*) and Mebane (*7*); detonations were heard in this region.

Within a few minutes, however, the earth will turn perceptibly under the active region; and thus the strewn field will be widened in longitude. Mebane records one direct observation of this phenomenon by the weather bureau at Alpena, Mich.

It is interesting to notice that this hypothesis furnishes a natural explanation of the fact noted by Beyer (*8*) that in the Indo-Malaysian fall, the tektites of Cambodia are much larger than those of the Philippines. The larger tektites should have a smaller ratio of drag to mass, and thus would be found west of the smaller tektites because they stayed up longer.

The explanation in terms of sedimentary rocks proposed by Barnes and Urey is difficult to reconcile with the almost total absence of water.

The explanation in terms of interstellar swarms postulated by Kohman (*9*) encounters the difficulty that once the particles had reached a state of rest, in contact with one another, the mass would be dense enough to be gravitationally stable, and would thus arrive undispersed at the earth's upper atmosphere. The limit of stability in the neighborhood of the earth is about 10^{-6} gm/cm^3. Kohman remarks that the presence of aluminum-26 and beryllium-10, in concentrations comparable with those found in stony meteorites, excludes the possibility of origin from the moon. The half-lives of these nuclides are, however, 10^6 and 2.6×10^6 years, respectively. It follows that if the tektites spiraled down to the earth in a compact swarm over a period of 10^7 years, as I have postulated, there would have been sufficient time to build up a near-equilibrium concentration such as that found by Kohman.

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Induced Growth of Diapausing Silkworm Embryos in vitro

Abstract. Fully diapausing silkworm embryos (*Bombyx mori* L.) ordinarily never reach the stage of appendage formation when they are cultured singly in hanging drops. However, when they are cultured side-by-side with nondiapausing embryos, they survive longer and some even achieve appendage formation.

Embryos from fully diapausing eggs of the silkworm *Bombyx mori* do not grow in vitro even when they are cultured in an extract of nondiapausing eggs in which nondiapausing embryos grow well (*1*). This is interesting in view of the fact that spermatogonia and spermatocytes from diapausing pupae of the Cecropia silkworm can be induced to grow and differentiate by in vitro culture in the blood of nondiapausing individuals (*2*). This difference in response may reflect some basic natural difference between pupal and embryonic diapause—that is, diapause in the pupal and in the egg state.

I have had a special interest in the mechanism of termination of diapause in insects, not only from a theoretical standpoint but also from that of practical needs in sericulture, and I have recently observed during in vitro culture experiments that fully diapausing silkworm embryos grow when they are cultured side by side with nondiapausing embryos in a hanging drop.

The results of side-by-side culture experiments carried out in 1958 are summarized in Table 1. Hanging-drop cultures were made in accordance with methods described previously (*1*), except for side-by-side explanation of embryos. The egg extract used for a culture medium was prepared from diapausing eggs stored at 5°C 2 days after deposition. In this medium nondiapausing embryos showed good growth when cultured singly, and all but two of 50 embryos reached the stage of appendage formation within 7 days, while 72 of 83 diapausing embryos cultured alone died within 5 days without attaining appendage formation. These are results one would expect from the data published previously. A noticeable finding evident in this table is the appreciable growth, or at least increased survival, of diapausing embryos cultured side-by-side with nondiapausing embryos. In 53 of 65 such side-by-side cultures, diapausing embryos survived for more than 5 days, and in nine they reached the stage of appendage formation. This improvement in growth, or increase in survival, cannot be attributed solely to coexistence of two or more embryos in one culture, because culture of two diapausing embryos in a drop had no effect on growth or survival; in all of seven such cultures the embryos died within 5 days. In the side-by-side cultures it was not necessary for diapausing embryos to come into contact with nondiapausing embryos for

Table 1. Induced growth of diapausing embryos through side-by-side culture.

Item	No. of embryos per culture				
	1 Nondiap.	1 Diap.	2 Diap.	1 Diap. with 1 nondiap.	1 Diap. between 2 nondiap.
No. of cultures	50	83	7	60	5
				65 (combined)	
Death within 5 days	1	72	7	12	0
				12 (combined)	
Survival more than 5 days	49	11	0	48	5
				53 (combined)	
Appendage formation	48	0	0	9	0
				9 (combined)	