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AN ANCIENT ACACIA WOOD FROM OREGON

By Irene Gregory*

A small, localized outcrop of tuff in central Crook County, Oregon, mapped as Clarno Formation of late Eocene to early Oligocene age by Waters (1968), has yielded fossil wood of both stem and roots of the genus Acacia. The paleobotanical occurrence is unusual in that fossil stem wood and root wood of the same species are rarely found together.

The occurrence consists of what is believed to be the remnants of a single tree. It lies horizontally in a matrix of fine-grained tuff in an outcrop area of about 200 square feet at the summit of a low hill. Although the leaves, twigs, and small branches are missing, limbs and roots 10 to 12 feet long (but segmented by earth pressures) and trunk sections are present. The prime condition of the wood, which shows no fungus rot, insect infestation, or distortion from drying, indicates that the tree was literally buried alive.

Conditions of burial and preservation can only be surmised. Possibly in Clarno time the acacia grew near a stream in the vicinity of an active volcano. Torrential flood waters undermined the tree, tore it loose, swept it along stripping it of its leaves and small branches, and finally left it stranded. Before the wood could deteriorate, it was buried by showers of volcanic ash and silicified. Erosion has now removed the volcanic cover and has exposed the fossilized tree, much of it still in place.

Photomicrographs of thin sections cut from the fossil wood (figures 1, 2, and 3) show structural details to be so well preserved that the diagnostic features necessary for identification are as definitive as in living wood.

Acacias in the Fossil Record

Reports of fossil acacias are few. Leaves are recorded chiefly from Eocene deposits of Alaska and Texas and from the Oligocene Florissant flora of Colorado. A well-preserved seed pod compared with Acacia farnesia (a tidal swamp species) is included in the Eocene Lower Bagshot flora of England -- a tropical lowland assemblage (Chandler, 1964). Deporta (1961)

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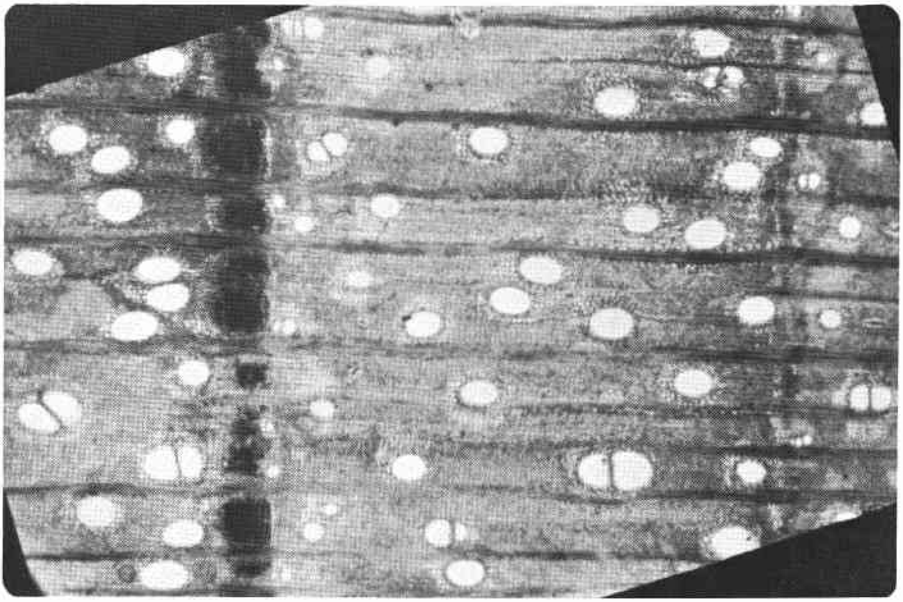
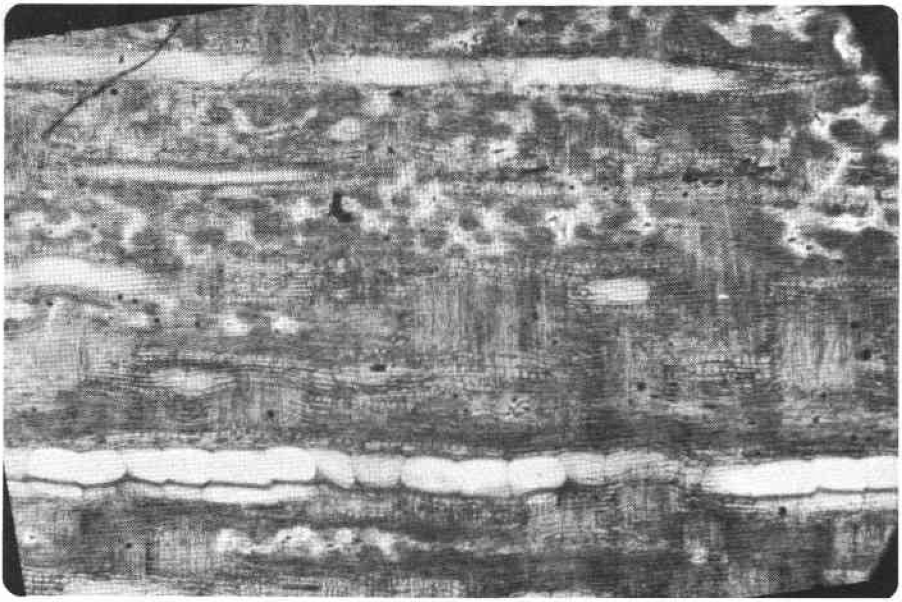
* Mrs. James M. Gregory is a fossil wood anatomist, Hillsboro, Oregon.



↑ Figure 1. Transverse (cross section) view of stem wood of the acacia. Magnification approximately X 30. Photograph by Thomas J. Bones.

↓ Figure 2. Radial view of stem wood of the acacia. Magnification approximately X 30. Photograph by Thomas J. Bones.



found *Acacia sp*. in an Oligocene-Miocene pollen flora of Colombia which includes palms and members of several subtropical angiosperm families such as *Malvaceae*, *Bombaceae*, and *Sapotaceae*.

Knowlton (1902) listed *Acacia oregoniana* Lesq., consisting of a nearly perfect complete seed pod, from the upper Miocene Mascall beds in Grant County, Oregon. But on the basis of additional collections of similar seed pods from the same locality, Chaney and Axelrod (1959, p. 207) have assigned Knowlton's specimen to *Albizzia oregoniana*.

As far as the author is aware, only one other specimen of fossil wood from the Pacific Northwest has been considered to be a possible *Acacia*. Prakash and Barghoorn (1961) report on a specimen they catalog as *Leguminoxylon occidentale*, as follows: "The nearest approach to the structure of the fossil which we have been able to establish is the genus *Acacia* and within this genus, the species *A. ferruginea*. One aspect of the fossil which renders its identification more difficult is the tangential compression failure which preceded mineralization, thus exaggerating the ellipticity of the vessels as seen in transverse section. In view of these facts, it seems more desirable to designate the fossil to family rather than to genus."

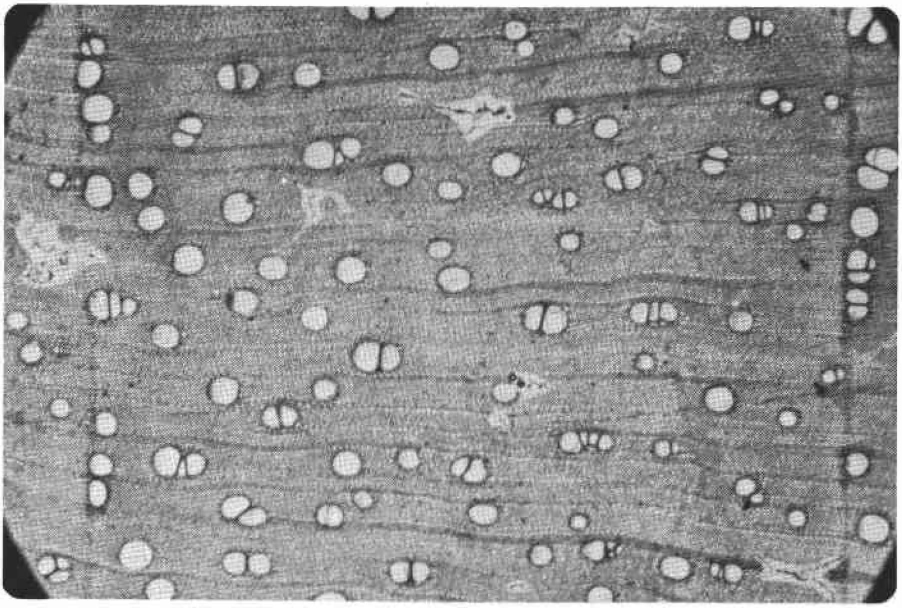


Figure 3. Transverse (cross section) view of root wood of the acacia. Magnification approximately X 30. Photograph by Thomas J. Bones.

Anatomical Description

Genus: Acacia
Sub-family: Mimosoideae
Family: Leguminosae

Growth rings: Indistinct and inconspicuous. Delimited by a fine line of sporadic terminal parenchyma with infrequent small vessels embedded in it. Rings vary greatly in width.

Vessels: Medium. Visible without lens. Diffuse-porous. In widest rings, those in center one-third of ring are largest. Some rings exhibit (at beginning and end of ring) a distinct zone of vessels smaller than those in rest of ring and embedded in the terminal parenchyma. Evenly distributed. 5 to 15 per sq. mm. Mostly solitary with a few radial rows of two (and less frequently) three cells. Occasionally, two cells are contiguous in the tangential plane. Also scattered irregular clusters or nests of mixed small and large pores (not present in every ring). Perforation plates simple; somewhat oblique. Vessel segments are short (0.2 - 0.4 mm.). Rather thick walled and forming conspicuous vermiform lines along the grain. Deposits of gum are frequently observed in the vessels. (In the fossil specimen these happen to be the same red-brown color as in the living wood.)

Parenchyma: Abundant vasicentric several cells wide forming a narrow halo around vessels or vessel groups. Also aliform with short wings. Sometimes confluent between two or three pores. Terminal parenchyma rather sporadic in a 3- to 4-seriate somewhat discontinuous line including or associated with a zone of small pores.

Fibers: Libriform. Rounded in transverse section. Thick walled. Not aligned radially but arranged in wide tracts between rays.

Rays: Medium. Visible without lens on cross-section. Approximately 5 per mm. Conspicuous on radial forming a cherry-like fleck. Slightly undulate around larger vessels. Homogeneous. Mostly 4 to 6 cells wide. 30 to 40 cells high. Also sparse 1- to 2-seriate rays a few cells high.

Intercellular canals: Vertical traumatic gum ducts arranged in tangential rows. Fairly frequent.

Affinities and Discussion

The genus Acacia today includes more than 400 species of trees and shrubs widely distributed over the tropics and subtropics of both hemispheres. Of these, more than 300 are native to Australia and the South Pacific islands. Native acacias nearest to the Crook County collecting area are those in the southwestern United States and Mexico.

While the fossil Acacia described here reflects closely the typical structural details of the living woods of this genus, to which it clearly belongs, assignment to a particular species is more difficult to establish -- particularly in the absence of such helpful diagnostic plant parts as leaves or seed-pods. Among the species of live woods available for comparison, its structure most closely approximates that of A. arabica, with which it is virtually identical in all major features. Minor differences include: fewer pores in the fossil wood (4 to 12 per sq. mm. in the fossil species and 5 to 15 per sq. mm. in A. arabica); somewhat smaller pore size in the fossil species; and fewer vessels containing gum deposits in the fossil species. (Obscuring by mineral stains as well as abnormalities of preservation might account for this apparent difference to some degree.)

A. arabica is indigenous to India, Arabia, and North Africa. It cannot withstand freezing temperatures but can adapt to a variety of environments, including lake and river banks as well as flood plains with repeated and prolonged periods of inundation.

New Fossil Species?

Further comparisons with additional specimens of living Acacia may prove beyond doubt that the Clarno fossil species has its closest affinity with A. arabica. The minor anatomical differences noted could then provide the basis for separating the fossil species from the closely similar living A. arabica and for the establishment of a new fossil species of the genus Acacia.

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* * * * *

GEOTHERMAL STEAM FOUND IN NEW MEXICO

What appears to be commercial-quality natural steam has been struck by a wildcat drilling rig in the Valles Caldera near Los Alamos, New Mexico, according to the Los Alamos Monitor, October 22, 1970. Previous exploration in this region had found mixtures of steam and hot water, but this well has apparently encountered a new zone containing dry steam. Numerous exploration wells in the West have tapped hot water at high temperatures and pressures, but up to now Yellowstone Park and the "Geysers" in northern California were the only known dry-steam fields in the United States.

The significance of the New Mexico discovery to Oregonians is that steam reservoirs are more widespread in the western states than previously supposed and that it is possible to find this source of energy through application of geologic knowledge and modern exploration techniques. Exploration for geothermal energy is not yet possible in most of Oregon, however, because all Federal land has been withdrawn from this type of prospecting. Consequently, there will be no opportunity to appraise the geothermal potential of this state, or of any other western state where a large share of the land is under Federal jurisdiction, until a Federal leasing law is passed.

* * * * *

TWENTY-YEAR INDEX TO ORE BIN PRINTED

The Department has just printed a 20-year index to The ORE BIN. The index is limited to articles signed by authors and is intended as a handy aid to finding the major reports published in The ORE BIN during the period of 1950 through 1969. The index can be obtained for 30 cents from the Department's offices in Portland, Baker, and Grants Pass.

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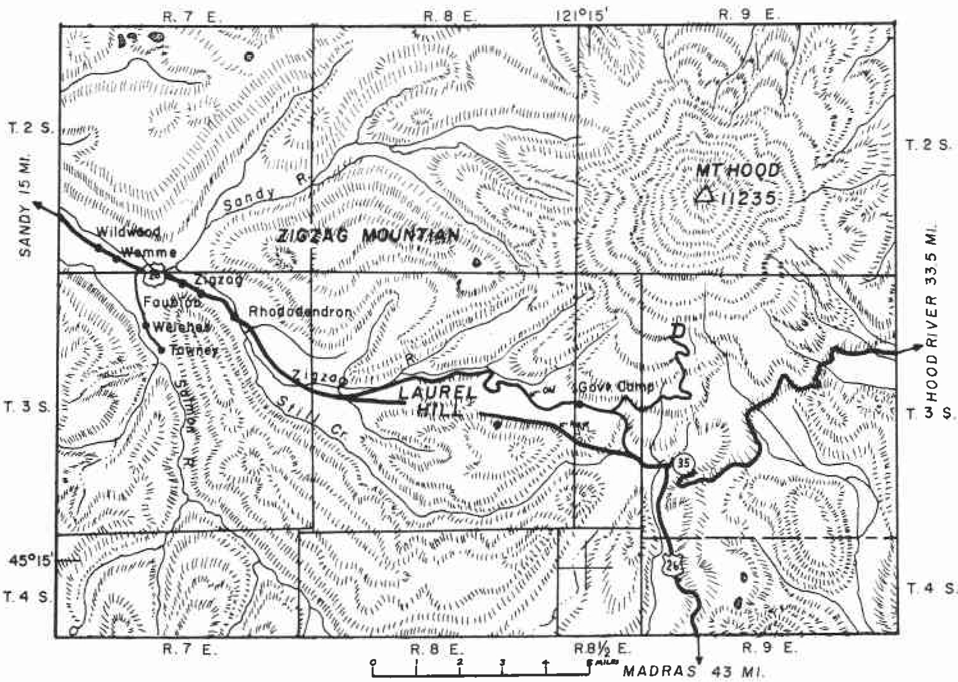
K-AR AGES OF LAUREL HILL PLUTON AND DIKE, OREGON

By Michael Bikerman*

Introduction

The Laurel Hill-Still Creek intrusions are situated on the lower reaches of the southwest part of Mount Hood in T. 3S., R.8 E. W. M., Oregon. Wise (1969), in a comprehensive discussion of the geology of the Mount Hood area, suggests that both intrusions are actually parts of one much larger pluton, which has been locally unroofed to give the two exposures. According to Wise (1969), the Laurel Hill-Still Creek body is a shallow pluton of quartz diorite intruded into late Miocene Rhododendron Formation (7-12 m.y. old) and early Pliocene lavas (4-7 m.y. old). An anomalous age of 11.6 m.y. was obtained for a whole-rock specimen of the Laurel Hill intrusion (Wise, 1969).



Sketch map of the Laurel Hill area.

* University of Pittsburgh Department of Earth and Planetary Sciences.

This paper reports two new K-Ar mineral ages from the Laurel Hill portion of the intrusion and a whole rock K-Ar date of one of a pair of andesite dikes cutting through the intrusion. These new dates are interpreted in light of the dates given in Wise (1969) on the Laurel Hill and associated volcanic rocks.

Sampling

The collection of the pluton samples was made by H. Ito of the University of Pittsburgh as part of a paleomagnetic study of the Laurel Hill intrusive (Ito and Fuller, 1970). The dike was sampled by the author at a later date. The three samples were collected from fresh outcrops exposed along U.S. Highway 26 between Rhododendron and Government Camp.

Age Determination Methods

The two pluton samples (Ito No. 509 and No. 512) were separated and analyzed at the U.S. Geological Survey in Menlo Park, Cal., in G.B. Dalrymple's laboratory prior to the completion of the author's laboratory. The techniques used in the U.S. Geological Survey laboratory for both argon and potassium analyses are discussed by Dalrymple and Lanphere (1969).

The technique used for argon analysis at the University of Pittsburgh is similar in many ways. The main differences are that we use a less sensitive MS-10 mass spectrometer which is run dynamically, and that our calibration is with known mineral separates rather than air. The argon spike is Ar^{38} from the University of Zurich. Sample fusion is by RF in a glass vacuum system. Clean up of gas from the fusion is accomplished by adsorption of water on zeolite, through reaction with hot (650°C) CuO, and with Ti foil.

Potassium analysis on the dike sample was done by John Anania using atomic absorption spectrophotometry. Duplicate analyses agree to within 1 percent of the amount reported.

Results

The two plutonic samples Ito No. 509 and No. 512 were split into hornblende and plagioclase samples, each of which was processed independently. The results (see table 1) indicate that the hornblende ages agree within experimental error at 8.2 m.y. The plagioclase separates both gave off much gas in fusion and contained more than 99 percent atmospheric argon and no useful age could be calculated from them. The hornblendes also contained a high atmospheric argon content -- a significant point for further discussion on the pluton.

The dike gives an age of approximately 5 m.y. (within the possible range of 4 m.y. to 5.5 m.y.). The uncertainty here is a function of a very

Table 1. K-Ar ages of the Laurel Hill pluton and associated dike.

Sample No.	Material	K%	Ar^{40*}	Atmos. Ar %	Apparent Age
Ito 509	hornblende	.26	3.885×10^{-12} m/g	86.4	$8.4 \pm .6$
	plagioclase	.39	(see text)	99.5	- - -
Ito 512	hornblende	.24	3.379×10^{-12} m/g	88.7	$8.0 \pm .6$
	plagioclase	.67	(see text)	99.3	- - -
M.B. 1-69	dike whole rock	1.15	1.025×10^{-12} m/g	20.0	$5.0 {}^{+.5}_{-1.0}$

low Ar^{36} peak leaving its actual height resolution somewhat imprecise. However, there is no question that the dike is younger than the pluton, which it intrudes.

Discussion

The age of 8.2 m.y. for the pluton is still anomalous, because it is older than the rocks into which it intrudes. The dike is of about the same age as the overlying andesites and might be part of the same system.

What are the reasons for the apparent discordance between the ages of the volcanic rocks and the pluton? Two main possibilities appear: 1) That the field relationship of the Laurel Hill pluton intruding the Rhododendron Formation and the overlying andesites is incorrectly interpreted, and actually that the contacts are in part or entirely volcanic rather than intrusive; or 2) that the K-Ar age of the Laurel Hill pluton is anomalously old.

Let us examine the first possibility. The field relations depend on interpretation of the contact regions. The contact zones were deeply weathered in the outcrops along the highway and were largely covered in the river valley just south of the road.

It is possible that the pluton intrudes the Rhododendron Formation without intruding the overlying andesites. If the Rhododendron Formation is Clarendonian (Wise, 1969) and if the range of Clarendonian time is 10-12 m.y. (Evernden and others, 1964) or from about 9.4 m.y. to less than 12.4 m.y. (Kistler, 1968), then the intrusion at 8.2 m.y. is consistent. If, however, the Rhododendron Formation is closer to 7 m.y. old as a hornblende age from a boulder in the lower part of the formation indicates (Wise, 1969), and if the Laurel Hill pluton actually intrudes the overlying andesites for which Wise (1969) reported an age of 5.5 m.y., then the second possibility must be considered.

In a discussion of anomalous ages we probably should include the age of 11.6 ± 1.2 on a whole rock sample of the pluton given by Wise (1969). This value points out the problem of whole rock K-Ar dating of coarse-grained crystalline rocks. The fact that the feldspars contain such a large excess of atmospheric argon (and incidentally unusually large total volumes of gas) would suggest that any whole rock analysis might be overwhelmed by atmospheric argon to the detriment of the precision and probably the accuracy of analysis. Not having the complete analytical data on Wise's (1969) results, any further discussion would be speculative.

The presence of the large amount of gas in the fusion of the feldspars, taken along with the high atmospheric argon and the broken appearances of the mineral grains as seen in thin section, suggests that this intrusion was emplaced rather close to the surface in a partially solidified state. The gas content (aside from argon) was not analyzed and may be largely water from meteoritic (and connate?) sources. Wise (1969) suggests that high water pressure was present at the time the feldspars crystallized, and that possibly it persisted through final emplacement, leading to water adsorption by the crystals of the pluton. It follows that a cool, shallow intrusive would not have the characteristic contact relationships to be expected. This may in part account for the field problems associated with the Laurel Hill pluton.

The second possibility -- that the pluton is younger than 5.5 m.y. old and that the hornblende K-Ar ages are incorrect -- must now be examined. If this is so, then the dikes most probably would fall at the younger end of their range, or 5 m.y. to 4 m.y. The occurrence of three events -- the extrusion of the 5.5 m.y. volcanics, the intrusion of the pluton into the volcanics, and the cutting of the cooled pluton by the dikes at 4 to 5 m.y. in less than $1\frac{1}{2}$ m.y. is not impossible but just a tight fit. If all the rocks were from the same magma chamber, then some of the objection might be lifted, especially if the dikes were actually as young as 4 m.y.

If the pluton is between 4 m.y. and 5.5 m.y. old, then the hornblendes from it must contain about 1.3 to 1.8 x 10^{-12} moles/gm of excess argon 40. This amount is less than that found in some anomalous hornblendes (Pearson and others, 1966; Damon and others, 1967), and hence this is a possible reason for the apparent age. The excess could, in part, be caused by the slow cooling of the parent magma at depth prior to intrusion, and the resultant memory of an older "age" in the hornblendes as finally emplaced. This remnant argon could be combined with or overshadowed by, absorption of radiogenic (and later on atmospheric) argon from the coexisting gas phase in the magma. There is no independent quantitative evidence for this, and the possibility of potassium loss further clouds the issue. With the present data the question of anomalous Ar^{40}/K^{40} ratios in the hornblendes from the Laurel Hill pluton versus anomalous field relationships leads the author to favor the latter choice. Certainly more field study of the pluton-volcanics contact is called for.

Summary and Conclusions

From the above discussion it appears that the Laurel Hill intrusion is most probably older than the 5.5 m.y. volcanics, and may very well be 8.2 ± .2 m.y. old.

An interesting, but circumstantial, corroboration of this age is obtained from the magnetic data (Ito and Fuller, 1970) which shows a reversal occurring in the Laurel Hill pluton. Nagata (personal communication, 1970) has found independent evidence for a reversal of this type occurring at 8.2 m.y. The pluton was, in turn, intruded by a dike at about 5 m.y., or penecontemporaneously with the volcanic activity at 5.5 m.y.

Acknowledgments

Special thanks go to Dr. G. B. Dalrymple for his kindness shown me in my short visit to his laboratory at Menlo Park, and for the analyses completed after my departure. I am very grateful to Hollis M. Dole and R. E. Corcoran for various services; to Drs. Ito, Fuller, and Schmidt and the Rock Magnetism Group for help in the field and laboratory; and to John Anania who did fine work on atomic absorption analyses for potassium.

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NEW MICROSCOPE HELPS FIND OIL

The photographs reproduced opposite were taken at the Pan American Research Center in Tulsa, Okla., using a remarkable new invention -- the scanning electron miscroscope. The equipment enables the research technician to magnify an object, such as a microfossil, as much as 50,000 times. The image is viewed on a small cathode ray tube similar to the screen of a television set. From the image provided by the tube, paleontologists, petrologists, and palynologists at Pan American can take photographs of greatly magnified minute fossils and rock particles. Photographs of these objects provide information about the oil-bearing formations that is vital in the search for petroleum reservoirs. An article in Pan Am's magazine, Horizons, (October 1969) describes how the equipment is used, as follows:

Palynologists use the scanning electron microscope (SEM) in the study of pollen, spores, and coccoliths, the skeletal remains of a minute form of marine life. These minute plant remains are keys in determining the age of rocks and are useful in correlation of subsurface strata.

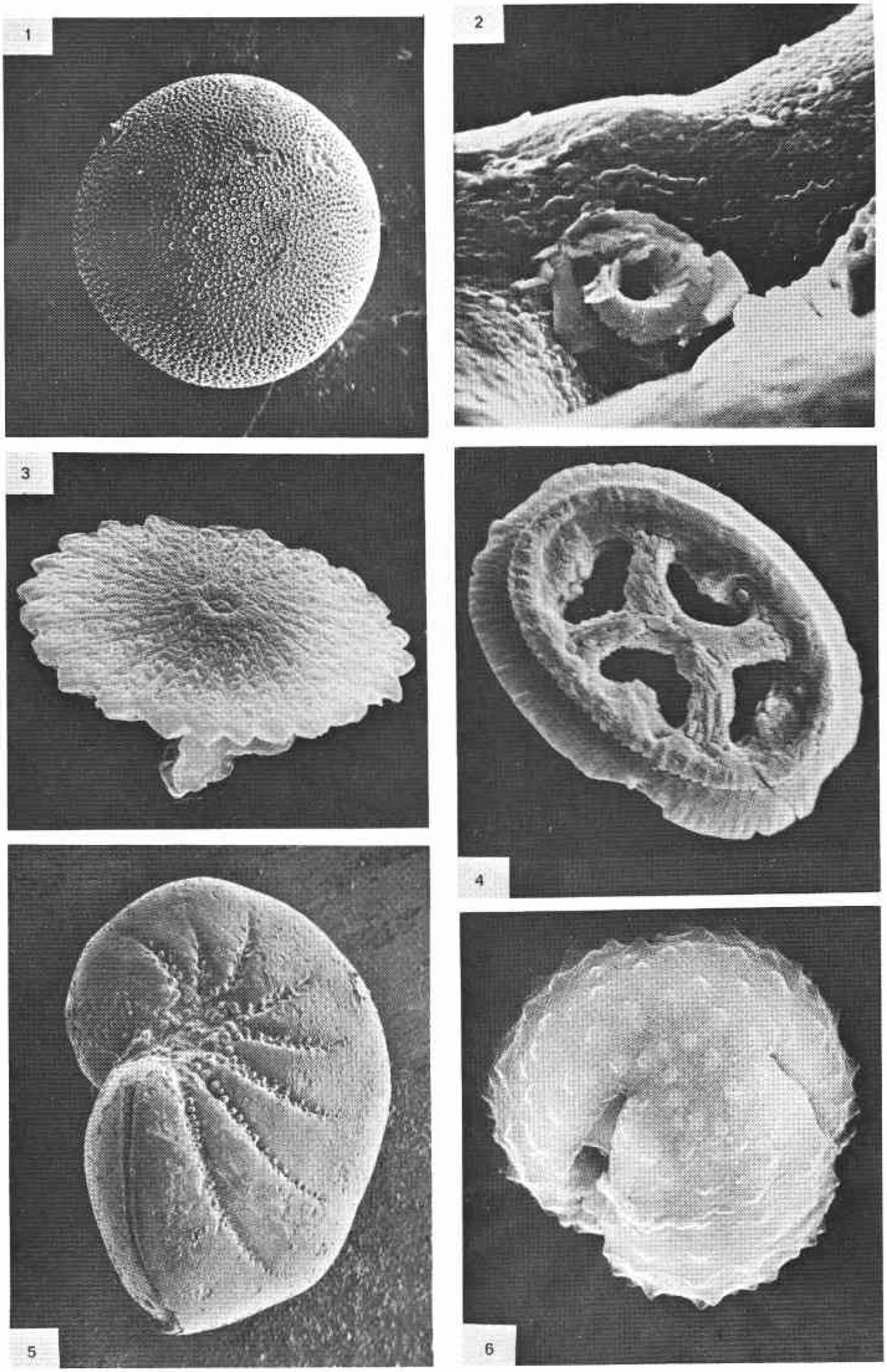
Petrologists use the SEM to examine the surface of minute sand grains; one objective is to determine how the grains are bonded together to form rock. A question which the SEM helps to answer is: Why do pores of some rocks hold oil and gas while those of others do not?

For example, tiny rock samples from two adjacent wells in Montana, one productive and one dry, were put under the scanning microscope. Examination of the photographs revealed that pores of rocks from the productive well were slightly larger than those from the dry hole, but more importantly, they were not clogged by fine-sized particles. With equipment available previously, the difference would have been difficult to see.

One of the most important uses of the SEM is in the study of fossil Foraminifera. These microscopic animals are the most widely used fossils in the oil industry, particularly in areas like the Gulf Coast. Ordinary photographic equipment has never been satisfactory for viewing the complex features of Foraminifera. But with the SEM, the paleontologist can for the first time obtain almost perfect illustrations, thus adding a new dimension to his ability to see and study these microorganisms.

Explanation of photographs

1. A tiny fossil foraminifer magnified X78.
2. A close-up of a pore of the same foraminifer magnified X7,340 reveals the skeletal remains of even smaller life within the specimen's pores.
3. Discoaster perpolitus (plant-like). Age 68 million years. X3,760.
4. Coccolithis grandis (plant-like). Age 45 million years. X3,850.
5. Florilus (foraminifer). Age 15 million years. X92.
6. Artemisia (pollen). Age modern. X 760.



Photographs courtesy Horizons, Pan American Petroleum Corp.

ASPINALL OUTLINES ACTION ON PLLRC RECOMMENDATIONS

At the American Mining Congress convention in Denver, Colorado, September 1970, The Honorable Wayne N. Aspinall, Chairman of the Public Land Law Review Commission, presented a paper in which he suggested a timetable for implementing the Commission's recommendations*. Excerpts from his speech, entitled "Future Public Land Policy -- where do we go from here?", are quoted as follows:

"Now that the Public Land Law Review Commission has submitted its report and recommendations, there remains the important unfinished business of obtaining a meaningful, constructive revision of the public land laws, including those laws affecting the discovery, development and production of mineral resources. As a result of our study one thing has been made clear: there is a vital need for such revision. Everyone -- whether praising the report or not -- agrees that we cannot continue much longer under the existing laws and procedures."

"We have not asked that each and every detail of the Commission's report be endorsed. We do ask endorsement of the basic principles, after which the details will be worked out by reasonable people to assure that the public interest is served. The many people who have dedicated themselves to the idea that there should be a meaningful revision of the public land laws make certain that progress will be made and action taken beginning in the 92nd Congress, which convenes next January."

"The questions most frequently asked are: How long will all this take? What will the time table be? What is the order of priorities?

"The very complexity of the subject matter makes it difficult -- almost impossible -- to have one or two omnibus bills that would embody all, or even a majority, of the Commission's recommendations. Compounding this situation is the divided jurisdiction among the various committees of Congress. An omnibus bill would immediately run into this problem. It obviously seems logical, as the first order of business, to determine whether we can implement the Commission's recommendation to place jurisdiction over public land matters in one committee of each House of Congress."

"Similarly, we should find out at an early date whether it is going to be possible at this time to carry out the Commission's recommendation to merge the Forest Service with the Department of Interior and thereby place in one department the four major public land management agencies. There is little point in pursuing legislation on the assumption that the Forest Service either will or will not remain in the Department of Agriculture apart

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* "One Third of the Nation's Land," the report of the Public Land Law Review Commission, containing 400 recommendations for revision of public land policies, was presented to the President and Congress in June, 1970.

from the other land management agencies.

"We can, in my opinion, determine these matters, of both legislative and executive jurisdiction over public land matters, rather quickly."

"We should also start work on implementing those recommendations the Commission has made concerning the basis of future public land policy. Such legislation might be introduced as an omnibus bill to cover all aspects of planning, including the establishment of goals and objectives for public land use, and the administrative procedures to be followed in conjunction with such use. This, we submit, would be in harmony with the concept of the legislation establishing the Commission, as well as with the Commission's view of building public land law on a foundation of principles. Interested groups, including yours, should be prepared to submit views on such legislation before you get to the point of recommending the terms of proposed legislation addressed to the specific problems of mining, or other particular uses of the public lands."

"Once we have established a firm foundation of policies upon which action is to be based, we can proceed to take up individual pieces of legislation dealing with various aspects. If we do not go about this with a plan for logical and orderly consideration of public land policy, we will find ourselves right back where we are today, with disjointed, uncorrelated laws.

"We recognize that this procedure will be time consuming. But, no matter how we view it, the process must be time consuming. It is going to take patience and the service of dedicated people to see this through. The legislative process will require that the bills be taken up in sequence through several Congresses. A Congress, as you know, runs for a period of two years and it therefore appears that it will take a minimum of six, eight, or ten years to implement substantially all of those recommendations made by the Commission that can and should be considered as being for the immediate future.

"In this connection, may I remind you that the Commission was looking forward to the year 2000, and that some of its recommendations are of a long-range nature, which none of us expect to be implemented immediately."

"...We urge each of you to become familiar with all of the recommendations and be ready to participate in the legislative process when it begins next January. We believe the Commission's report provides an excellent starting point for the legislation that is necessary. With the help of all concerned citizens, and citizen and industry groups, we know that this next phase of the work will be completed -- just as the last phase was -- within a time frame that will be reasonable while giving full consideration to the public interest."

* * * * *

HOW TO JOIN THE CLUB*

All you have to do to belong to the wildcatters' club is to hire a drilling rig, lease some undrilled land, and dig a hole in the ground from 5 to 25,-000 feet deep and hope you find oil or gas. This makes you a bona fide member of the club.

The average hole price for shallow wells ranges $15 to $20 a foot and the well deeper than 15,000 will cost you about $700,000, and the world's deepest well, 25,340 feet, cost three million.

Members' benefits include the fun of grinding up diamond bits, paying high interest rates on borrowed money, pumping drilling mud in and out of the hole, and risking a blow-out that wipes out your investment over night. It's sort of like playing financial Russian roulette with a howitzer.

Your chances of finding enough oil or gas to make a profit are about two out of a hundred holes, so you see you could sink a lot of bread before you chickened out.

For 39 years the Oil Scouts have listed every wildcatter's well in a big black book called "International Oil and Gas Development." The Scout's 40th Year Book names 9,654 United States wildcatters who joined the club in 1969, and tells you where and how they spent their money. Obviously, one can't list them all here, but just the deepest holes drilled (in states west of the Mississippi) in 1969 will chill your Scotch blood.

In Alaska, six wildcats out of 30 hit pay, and oil men spent more than 900 million dollars there in 1969 just for leases. Here again the year's deepest well, drilled to 15,454 feet by Shell Oil on federal land, was a duster.

In central California, Standard Oil of California drilled the deepest well of the year to 12,572 feet -- it was dry. Offshore of California, Humble drilled the year's deepest well -- also dry at 15,456 feet. In southern California one deep well produced oil when Continental Oil Co. drilled to 13,630 feet for a new pay in the San Miguelito Field, and Standard of California drilled a dry hole to 13,868 feet.

In Colorado, wildcatters drilled 500 exploratory tests and only 64 found oil or gas. The deepest test went to 16,381 feet, and finally produced new gas at 2,200 feet in the Lay Creek Field. The deepest tests in Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, and South Dakota were all dry.

In Texas, the deepest test in San Antonio, North Texas, Panhandle and West Texas found production. A 16,580 test by Cherryville Corp. in East Texas, a 17,622 foot test in Gulf Coast by North Houston Operators, a 7,256 test in West Central Texas by Westrons Petroleum were all dry.

In Utah, Flying Diamond drilled the deepest hole -- dry, to 11,420 feet, and in Wyoming, Marathon drilled deepest test to 19,817 feet -- and by now you know. It was dry.

*Excerpts from Internatl. Oil Scouts Ann. Pub., v. 11, No. 9, Sept.1970.

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Geologic map of Oregon west of 121st meridian: (over the counter) . . . . folded in envelope, $2.15; rolled in map tube, $2.50	2.00
Gravity maps of Oregon, onshore and offshore, 1967: [Sold only in set]: flat . folded in envelope, $2.25; rolled in map tube, $2.50	2.00

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