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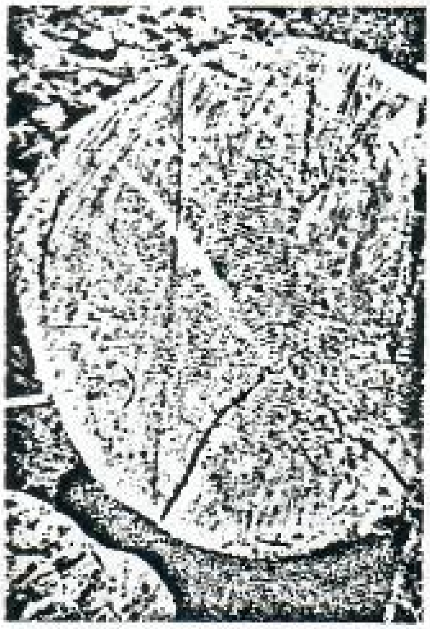
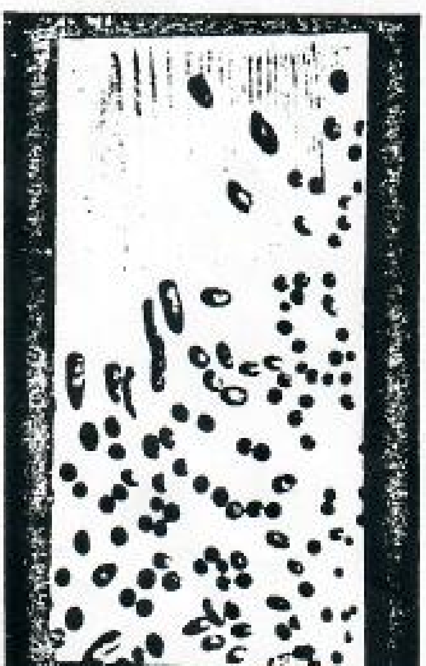
LARGE DOUGLAS FIR, new arrival, near Mokapu Point, Oahu. Section of bark still on log. (Photo by C. C. Strong and Richard A. Strong).



TAHSIS CO. brand (B.C.) on Douglas fir log near Kaupo, Maui.

BRANDS not yet identified.



BOARD CUT from teredo-bored western hemlock log at mill of Hawaiian Fern-Wood Products, Hilo, Hawaii. Contributed by Myron Wold, owner and manager.

IF YOU'RE LOOKING for adventure and see a big log drifting down a flooded Pacific Northwest river, jump aboard. If you survive, you may get a free trip to Hawaii. That's the word from several members of the Hawaii State Forestry Division and the Hawaii research unit of the U. S. Forest Service who turned beachcombers in 1961 after finding a branded log from the West Coast on the windward side of the island of Maui.

In a year of leisure-time study, these men turned up 561 logs, broken logs, tree trunks, and large cull pieces that had made the trip; 360 were full logs or trunks.

Ten logs, despite severe battering against cliffs and reefs, still had company brands showing on the ends. Five branded Douglas fir logs had the tree farm license and cutting permit number of the Tahsis Company, operating on Gold River, Machalat Inlet, Vancouver Island. Two Tahsis Company logs were 20 miles apart on east Maui, one was near South Point on Hawaii, another near Kailua on Oahu, and the fifth near Kealia on Kauai.

Menasha Wooden Ware Corporation, of North Bend, Oregon, lost a log which found its way to a beach on the Navy target island, Kahoolawe. Four other Northwest companies unwittingly contributed branded logs to the Hawaii beaches.

Authors Roger Skolmen, front, and Clarence Strong, far end of nearly buried Philippine mahogany log, island of Kahoolawe, Hawaii.

Floats Logs to Hawaiian Shores

from Pacific Northwest and British Columbia

Early in the study, a trip to the Bishop Museum in Honolulu brought help from the museum staff and some reference books in which the following quotations appear:

" . . . it should also be noted that many of the largest and most famous double canoes of the Hawaiians were hewn from logs of Oregon pine brought to the shores of Niihau and Kauai by the waves. I, myself, saw dozens of such logs in 1864, some of great size, some bored by teredo, others covered with barnacles, along the shores of Niihau . . . "[1]

"The timber usually employed in making the dugout underbodies of ordinary canoes was the koa (Acacia koa), a hardwood which has been marketed as 'Hawaiian mahogany'; but whenever it was possible to procure them, trunks of Oregon pine were preferred for their greater size. These were not infrequently cast up on the shores of the Islands, particularly Niihau and Kauai. . . .

The flotsam from the west coast of North America was eagerly sought for and any exceptionally fine trunk was hoarded by the local chief for the construction of a specially large double canoe; the difficulty was to obtain a companion of equal size. Vancouver (1798, Vol. 2, p. 219) records that the chief Taio kept one gigantic trunk unworked for a long time in the hope of finding another to match it.

Disappointed in this, eventually with great reluctance, he utilized it for the hull of one of the largest outrigger canoes ever made in the Islands, 61.5 feet in length and of depth and beam proportionate."[2]

[1] From an index to the Islands of the Pacific Ocean. A Handbook to the chart on the walls of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History, by William T. Brigham. 1900. 12pp.

[2] Canoes of Oceania, by A. C. Haddon and James Hornell. Vol. 1. The Canoes of Polynesia, Fiji and Micronesia, by James Hornell.

"Some very large Hawaiian canoes were made from the great California redwood logs which drifted to these shores. The rotting hull of one 108 feet long was still to be seen in the 1870's."[3]

We modern beachcombers were not as fortunate as Mr. Brigham in finding entire trunks of the "Oregon pine." But some of the 561 logs and pieces we found were very large, and believe that many more are lodged in little-frequented bays or are adrift on inter-island waters.

Drift logs land on the windward shores and bays of all the islands of the State of Hawaii. We checked less than one-fourth of the windward shores, omitting the Islands of Niihau, Molokai, and Lanai although numerous logs have been reported on all of them. One the big island, Hawaii, 149 pieces were found on less than 15 miles of its 200 miles or more of windward shores.

Many of the logs had been cast up on the beaches years ago and were in various stages of decay. Some had been lifted high on the shores by tsunami (so-called "tidal waves") and a few carried as much as 150 yards behind high sand dunes. Some were partially buried in the beach sands. Others were perched precariously on the sharp rocks above rocky shorelines.

Inquiries of small mill operators on Oahu and Hawaii reveal that some drift logs have been sawed for various purposes. Many boards have been cut from teredo-infested logs for decorative and specialty uses. Other logs drifting in on heavily used windward beaches have been consumed in beach fires. Still others have been cut for posts and for yard use by beach dwellers.

[3] Ancient Hawaiian Civilization. (A series of lectures delivered at the Kamehameha Schools; from Chap. 22, page 238.) Narration by Kenneth P. Emory.

What are the species represented? Of the 561 pieces counted, 162 were checked for species and other data. Ten were species from Western North America, 6 were from Japan, and the Western and Southwestern Pacific. Of the North American species, 69 were Douglas fir, 26 western red cedar, 24 redwood, 6 white or grand fir, 4 Port Orford-cedar, 4 western hemlock, 2 western white pine, 2 cottonwood, 1 Sitka spruce, and 1 red oak.

From the Western and Southwestern Pacific came 6 **Shorea** and **Parashorea** (Philippine "mahoganies"), 2 **Agathis** (**Kauri**), and 1 log each of Melia, Kapur, Kodsura (probably from Japan), and **Podocarpus**. Several podocarps grow in Central America, but the one found in this study probably came from the Southwestern Pacific. One primavera log was found; this is a Central American species but since it was planted in Hawaii years ago, the log we found could have originated locally.

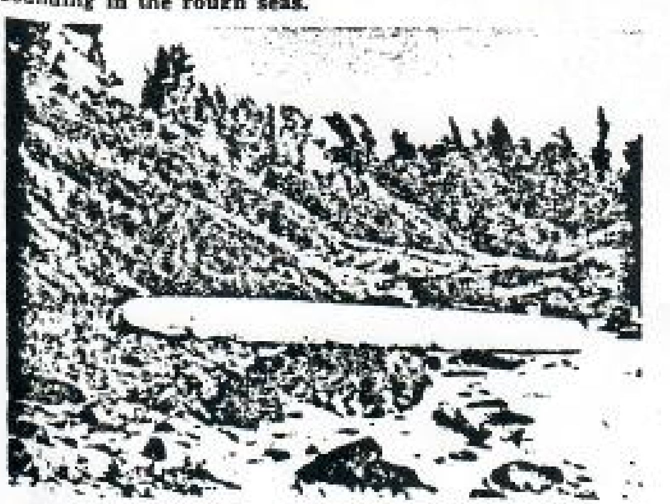
Kapur (**Dryobalanops** spp.) grows only in Borneo, Sumatra, and Malaya. It is not exported in log form from Malaya, according to the Department of Forestry there. We have no similar information for Borneo or Sumatra.

The rest of the logs examined and recorded proved to be from species that grow locally as well as on other Pacific Islands. These were assumed to be of local origin. Throughout the study, any logs that could be identified on the spot as of local origin were not recorded.

Logs and chunks of the softer

(Continued on Page 32)

WESTERN RED CEDAR log near Kealia, Kauai. Ends are rounded by months of battering on rugged shores and pounding in the rough seas.



ANOTHER SPECIES of log cast up on Hawaiian shores was one of the Philippine mahoganies, here being examined for tell-tale brands or marks to establish its origin.

INDUSTRY POLICY FOR TIMBER ACCESS ROADS

The lumber industry favors the enactment of Federal legislation authorizing adequate funds for the construction and maintenance of mainline timber access roads to make possible adequate management of Federal forests with the following recommendations:

1. That such Federally financed roads be designed and located chiefly for the purpose of removing timber;
2. That location and design of roads be jointly planned with timber purchasers;
3. That road standards and road limits on such Federally financed roads be sufficiently flexible to take advantage of logging opportunities and operating economics;
4. That only such mainline roads as cannot be quickly and adequately financed by private timber operators as part of timber sales be constructed by the Federal Government;
5. That timber access road use charges be left to negotiation between prospective users, the Federal Government and cooperative contributors, and;
6. That the provision in present law under which private owners are permitted to cross national forest land to permit ingress and egress to and from their own lands should not be repealed or limited so as to destroy existing and long accepted rights of private owners. These provisions are fair and equitable and consistent with fundamental principles of the common law.

The Lumber Industry supports such actions as may be needed which would permit the Secretary of Agriculture to:

1. Grant permanent or temporary easements over lands under his jurisdiction;
2. Exchange easements by mutual agreement;
3. Terminate easements under fair and equitable procedures;
4. Construct such mainline timber access roads as cannot be quickly and adequately financed by timber purchasers;
5. Obtain needed funds by direct appropriations to replace funds lost if the law allowing the use of 10 per cent of timber sales receipts for roads and trails is repealed as recommended by the lumber industry;
6. Enter into agreement with private timber owners for road use and construction;
7. Charge maintenance fees for road use when road maintenance cannot be provided on a practical basis by the user.

tation problem from the stand-point of his equipment and experience. As a result, there is much room for differences over road standards and costs.

According to many experienced operators, unusually-high standards have resulted in unnecessarily-increased road costs. Specific examples are given to support their claims.

TIMBER CARRIES THE LOAD

National forest road needs are great. The Forest Service reports that Montana and Idaho each need to construct or reconstruct about 70,000 miles of forest development roads. California's needs are given at more than 53,000 miles. The national forests of Oregon and Washington have 29,500 miles of development system roads and 26,300 miles are planned for construction in the next ten years.

Significantly, the Forest Service in Region Six says:

"Most roads built in the next decade will be constructed by purchasers of government timber, as part of the necessary cost of removing timber from a sale area. (Roads built by timber purchasers under sales contracts amounted to 96.5 percent of all roads built in the Pacific Northwest Region for the Forest Service in FY 1961.)"

ROAD SUBSIDY SHOULD GO

While some people outside of the industry would favor the elimination of the "prudent operator" concept because it restricts road-program financing from timber, there appears to be room to question its application from the opposite side — from the standpoint of charging too much road cost to the timber in one sale. In fairness to both the operators and the counties, this practice should be examined.

If a large block of timber, scheduled to be tapped by a new road, were in private owpership rather than being a part of a national forest, the owner would never be permitted to write off the road cost on three years of production from the area, as is done with national forest timber. He would be required to handle the road as a long-term investment to be amortized over many years.

The government is planning to charge other timber owners for permission to haul logs over national forest roads and thus help pay for their construction. When this is done, some arrangement should be made to charge other users, including recreationists, for their share of the cost. The latter could be done, of course, with appropriated funds and should be considered "a necessary cost" of providing recreation.

The important point here is that the entire road cost necessary to remove the timber in one sale (which may have been stretched in size to cover inadequately the road cost) should not be borne entirely by that sale when other timber or other uses will benefit.

Further refinements are needed in the procedures for amortizinz roads built by timber purchasers, so that the roads-for-stumpage payments do not continue to increase. Timber purchasers and county governments should be relieved of the burden of subsidizing the national-forest road system.

Timber Sales Top Million In Rocky Mountain Region

National Forests of the Rocky Mountain Region showed an increase in timber sales for fiscal year 1962 over 1961. Figures show that lumbering is a million dollar industry in the region.

The 15 National Forests in Colorado, Wyoming and South Dakota sold 298-million board feet during the period, as compared with 279-million the preceding fiscal year. The sales value averaged $4.90 per thousand board feet or a total of $1,031,132.

While sales were up, timber harvest was down 6% for the same period; 223-million board feet were cut in 1962, as compared with 237-million in 1961. Variance in sales and harvest result from timber harvest contracts. Operators who bid for timber in 1962 may not necessarily log off the sales area that year. On some large, extended sales, many years may elapse before the cutting has been completed. Thus, in any given year, the amount sold may not be the same as the amount cut.

Two forests in the region reached cut quotas and went over the top this past fiscal year. Shoshone National Forest in northern Wyoming hit 126.05% of its quota, and the Roosevelt in northern Colorado, 113.53%.

The Arapaho, San Isabel and Routt national forests, all in Colorado, were within 90% of established quotas. Regionwide the cut was about the same percent of the regional quota as in fiscal year 1961.

Timber cut quotas for the Rocky Mountain Region were 322-million board feet and the fiscal year cut total was 223-million, or 69.17% of the quota. The record of the previous year saw a total of 237-million board feet cut.

The region established a 1961-62 sales quota of 785-million board feet and hit 37.93% of that quota.

Hawaiian Shores

(Continued from Page 25)

woods were badly worn and the ends battered so badly that no log brands were visible. Any piece that had escaped battering on the rocky cliffs came through in fairly good condition. Some newly arrived Douglas fir logs were in remarkably good condition.

All of the hardwood logs from the Western Pacific were likewise in excellent condition; some of them still had iron fasteners in end-splits to prevent further opening during drying. Bark was gone from most of the logs although a few small patches of bark were still attached to some Douglas fir and cedar logs that had not been severely pounded on the coral reefs. Most barnacles apparently were knocked off on the reefs.

Teredos played havoc with all logs, except some of the hardwoods. Some were more heavily attacked than others of the same species, probably indicating a much slower trip.

From whence came these logs? This is the $64 question. Reference to any good chart of the Pacific Ocean currents indicates clearly that logs will drift naturally to Hawaii from the North Pacific Coast of the mainland and also from California. Currents in the Western Pacific flow south and southeastward past Malaya, around the southern tip of Borneo and northeastward through the Makassar Straits into the Celebes Sea.

The Japan current (the Kuroshio) takes off northward from there, goes past the Philippines and Japan, then turns east as the North Pacific current. This latter goes straight across the Pacific, almost to the Pacific Coast where it partially mixes with the Subarctic current to become the southerly moving California current. The California current could feed logs from the Western Pacific, California, and the Pacific Northwest into the North Equatorial current which moves to and beyond Hawaii.

Chances are the pieces from the North American coast drifted to Hawaii on the natural current. Many of the pieces were cull logs, large chunks, or parts of broken logs which no one would transport here. Proof is lacking that all the logs from the Western Pacific drifted the entire distance to Hawaii.

They could well have done so, but they could have been transported part way on some ship, from the Philippines towards Japan perhaps, and lost overboard enroute. We are sure they drifted at least part of the way because they came ashore where no ship could approach closely. In addition, the only species Hawaii imports in log form is monkey pod, and we found none of this species.

There are sure to be many logs on Hawaii shores not recorded in this study, perhaps some from even more distant lands. But evidence already at hand makes it perfectly understandable why the eyes of the honored Kahuna Kalai Wa'a—the expert canoe builders—were always turned to the windward shores in anticipation of the arrival of those great tree trunks from North America.

The Kahuna Kalai Wa'a and their ancestral gods, 'aumakua, have mostly retired to their honored resting places. But the logs still come, unheralded and often unnoticed.

So come along you lumberjacks,
Pack your tools and gear,
There's logs to yard in Paradise,
And not a soul who cares.

Pick yourself a big Douglas fir,
Shove off in the salty pond,
Toss a line to Moby Dick,
Have patience, it won't be long.

And when you near those coral shores,
Listen for the chorus,
From many logs on cliffs and beaches,
Should come a loud "Aloha."

Budworm War

(Continued from Page 45)

tion of 1½ billion board feet of timber worth an estimated 18 million dollars.

After months of detailed preparation and planning, the aerial counterattack began at dawn on June 25. Once started, the project was not without its frustrations. Wind kept the planes grounded one day, and there were six days when there could be no spraying because the insect had not yet reached a susceptible stage of development. The last flight was made on July 11.

Ten days later, results of field checks showed a 99.1 percent mortality of the budworm larvae.

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Table 1

Track No. on fig.	Dept of Mines and Tech. Surv. or Project Magnet No.	Height (ft.)	Position of points marked by circles
1	*PM* 008	11,000	60° 01′ N. 029° 00′ W.
2	*PM* 80	10,000	57° 33′ 035° 00′
3	*DS* 20 (*B*)	9,000–11,000	57° 02′ 033° 08′
4	*PM* 73	7,000	53° 02′ 035° 40′
5	*DS* 23 (*B*)	8,000–10,000	53° 10′ 035° 12′
6	*DS* 13 (*A*)	9,000	52° 25′ 029° 25′
7	*PM* 106	15,100	47° 24′ 027° 20′
8	*PM* 109	7,000–9,100	39° 08′ 030° 03′
9	*PM* 76	9,000	34° 38′ 036° 20′
10	*PM* 114	8,000–10,000	31° 56′ 040° 24′

Note.—Project Magnet lines marked *PM*, Department of Mines and Technical Survey lines marked *DS*.

The tracks of the flights are shown in Fig. 1, in relation to the approximate position of the central part of the Mid-Atlantic Ridge. This has been plotted from the map prepared by Heezen *et al.*[2] and from the British Admiralty Chart 1904. Track 8 is to the west of the Azores and track 7 passes over the Ridge at about 47° N. Two flights, 4 and 5, are close together and were made independently by Project Magnet and by the Department of Mines and Technical Surveys respectively.

Profiles of the total field along these tracks are shown in Fig. 2. There is a regional trend which has not been removed. The observations have been plotted against longitude and the points which lie on the dotted centre line of Fig. 2 correspond to the circles on the tracks of Fig. 1. There are peaks on the profiles of tracks 1–5 between 60° N. and 53° N., on track 8 at 39° N. and on track 10 at 32° N., and these vary in size from about 200 gammas to 800 gammas. The peaks on the profiles of tracks 1 to 5 and track 10, and one of the peaks of track 8 lie on or close to the central part of the Ridge. A flight adjacent to track 8, which is not shown, also has more than one peak on its profile in the area to the west of the Azores. There are no peaks on tracks 6 and 7 at 52° 25′ N. and 47° 24′ N. respectively. The peaks of tracks 4 and 5 are separated by several kilometres.

These results suggest that a magnetic anomaly is associated with some parts, but not all, of the central portion of the Mid-Atlantic Ridge, which agrees with the observations made by Ewing and others[1] and by Hill[3]. The apparent lack of coincidence of the peaks of the profiles with the exact centre of the Ridge is unlikely to be significant in view of the uncertainties in navigation.

I thank the Department of Mines and Technical Surveys of Canada and the U.S. Hydrographic Office for making their results available to me. This work was supported by the National Research Council of Canada and by the Defence Research Board of Canada.

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[1] Ewing, M., Heezen, B. C., and Hirshman, J., Comm. No. 110, *Assoc. Seismol. Assoc. Gen. U.G.G.I.*, Toronto (1957).
[2] Heezen, B. C., Tharp, M., and Ewing, M., *Spec. Paper* 65, Geol. Soc. Amer. (1959).
[3] Hill, M. N., *Deep-Sea Res.*, 6, 193 (1960).

OCEANOGRAPHY

Origin of Drift-logs on the Beaches of Hawaii

PACIFIC ocean currents can carry objects to the Hawaiian Islands not only from North America, but also from Western Pacific islands and perhaps from the mainland of Asia. This is our conclusion from a recent examination of logs that have drifted to beaches of all the main Hawaiian Islands.

We were stimulated to pursue this investigation by the forester's interest in the species and forest areas represented in these logs, but we have learned that our findings may interest oceanographers, botanists, and others concerned with the part that ocean currents have played in the development of the Islands.

Most of the logs were from the west coast of North America: Douglas fir, western red cedar, and redwood were most frequent (Table 1). The origin of some of these could be pinpointed by checking brands placed on the logs by west coast timber companies. But some logs were of species native to such far-away places as the Philippines, Japan, and Malaya.

Table 1. SPECIES, NUMBER, AND ORIGIN OF LOGS FOUND ON THE BEACHES OF HAWAII

Species	Common name	No. examined	Probable origin
Pseudotsuga menziesii	Douglas fir	75	W. North America*
Thuja plicata	Western red cedar	27	W. North America
Sequoia sempervirens	Redwood	25	California
Abies spp.	True fir	7	W. North America
Tsuga heterophylla	Western hemlock	4	W. North America
Chamaecyparis lawsoniana	Port Orford cedar	4	W. North America†
Pinus monticola	Western white pine	2	W. North America
Picea sitchensis	Sitka spruce	1	W. North America
Quercus sp.	Oak (red)	1	W. North America
Populus sp.	Cottonwood	1	W. North America
Shorea spp.	Several 'Philippine mahoganies'	6	Philippines
Parashorea bagtikan	'White Lauan'	1	Philippines
Cercidiphyllum japonicum	Kadsura	1	Japan
Dryobalanops sp.	Kapur	1	Malaya, Borneo or Sumatra
Melia sp.	—	1	Philippines or S.-W. Pacific‡
Agathis sp.	—	1	Philippines or S.-W. Pacific
Albizzia sp.	—	1	Philippines or S.-W. Pacific‡
Podocarpus sp.	—	1	S.-W. Pacific or Chile
Cybistax donnell-smithii	Primavera	1	Central America‡

* Five logs carried brand from Gold River, Vancouver Island, British Columbia.
† One log carried brand from Coos Bay, Oregon.
‡ Possibly of Hawaiian origin.

It is quite certain that none of the logs listed in Table 1 arrived other than by drifting. The only logs Hawaii imports are monkey-pod (*Samanea saman*) from Fiji, and her forests grow only a few of the species listed. In all but three cases, Hawaiian forest trees could not produce logs as large as those found. Wood identification of the lesser known species was provided by the U.S. Forest Products Laboratory, at Madison, Wisconsin.

Since logs float very low in the water, they should be little influenced by wind action. The movement of drift logs is therefore probably due almost entirely to ocean currents.

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PHYSICS

Multiple-beam 'Transmission-like' Fizeau Fringes in the Reflexion Interference System

MULTIPLE reflexions between close, nearly parallel surfaces of high reflectivity give rise to the well-known sharpened Fizeau fringes of equal thickness[1]. For two surfaces of equal reflectivity R and equal transmittivity T, neglecting absorption, the successive interfering beams in the transmitted system have intensities $T^2, R^2T^2, R^4T^2 \ldots = T^2(1, R^2, R^4, \ldots)$. For the reflected system the intensities are $R, RT^2, R^3T^2 \ldots = R, RT^2(1, R^2, R^4, \ldots)$. As shown by Tolansky, the Airy summation of the corresponding amplitudes is valid for non-parallel plates provided certain conditions are met, and we thus obtain the intensity distribution of the transmitted and reflected fringe systems. It is found that, except for the term R

ad neglecting ... ectivities). the ... itted series. T ... flected from the ... minated from ... actly the trans ... ensity by the ... ringes (minima on ... s' (maxima on ... ringes of equal i ... s the effect as "a ... case".

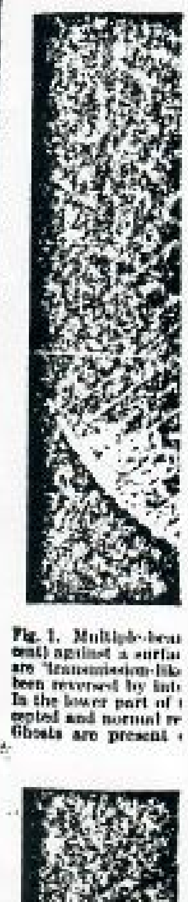

Fig. 1. Multiple-beam ... ent) against a surfac ... are 'transmission-like ... been reversed by ... In the lower part of ... epted and normal re ... fibosls are present

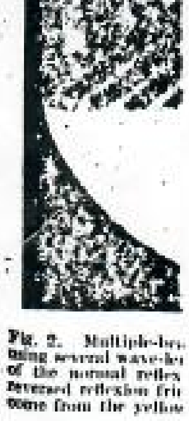

Fig. 2. Multiple-be ... bing several wave-le ... of the normal reflex ... reversed reflexion fri ... tone from the yellow