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William Morton Wheeler

THE TONGA EXPEDITION OF 1926

The primary object of the expedition was to make such progress in the investigation of the geologic and biotic history of the Tonga archipelago as might be possible during the months of June, July and August. The personnel of the expedition consisted of J. Edward Hoffmeister, of the University of Rochester (geology and corals), J. M. Ostergaard, of the University of Hawaii (mollusks) and Harold Ernest Parks, Mrs. Setchell and myself, of the University of California (botany). Hoffmeister and Ostergaard were directly under the patronage of the Bernice P. Bishop Museum, and the expedition as a whole was under the auspices of the same institution.

The delay of a week at Suva, Fiji, was utilized in making studies of the barrier reef and the geology and botany of the vicinity, in close sympathetic cooperation with Harry S. Ladd, Bishop Museum Fellow, who had been at work in Fiji for several months. From May 31 to August 23 our work lay in southern Tonga. Hoffmeister and Parks devoted most of their time to investigations on Eua, the remainder of their time being spent on Tongatabu, where the rest of the party were located during their entire stay. Particular attention was given to collecting corals, mollusks, foraminifera and nullipores, both living and fossil, since these constitute the bulk of the organisms preserved in the emergent reefs and are likely to be of the greatest importance as indicators of time and temperature relations. The distribution of land plants was also determined, both from the ecologic and floristic standpoints, as being likely to show similar and corroboratory relations.

Returning, our party spent a profitable day in the vicinity of Neiafu, the port of the island of Vavau, about three days at Apia, in western Samoa, and about three days again at Suva. In regard to the biotic data obtainable, it is pertinent to state that our observations were confined entirely to the winter (cooler and usually drier) season, and is lacking in material and data peculiar to the summer (warmer and moister) season. A very considerable amount both of data and material was accumulated, but detailed reports must await its study and coordination. Here may be briefly outlined, however, the main trends of our work.

Brief Report of Botanical Work

(By William Albert Setchell)

The island of Tongatubu presents a very simple plan of plant distribution. In many places along the steep, high windward side (the liku) is a wind-swept forest formation bordered towards the ocean by a dense Pandanus association and with a low herbaceous or prostrate undershrub formation to the edges of the lower or higher cliffs. This liku forest varies somewhat in the outer associations but within is typically a Myristicetum (with *Myristica hypargyraea* as a strong dominant) over the higher portions of its range. The low leeward shore shows chiefly a succession of sandy beaches, bordered seaward by a dead fringing reef and landward by a beach standing several feet (usually about ten) above mean low water mark. Along this beach are herbaceous formations with typical Polynesian strand trees and shrubs. Between the liku forest formation on the windward ridge and the leeward formations, the gently sloping agricultural land is covered with plantations of coconuts, bananas, taro, sweet potatoes, yams, etc., interspersed with larger and smaller patches of secondary forest or bush. Through this area are scattered a few low conical hills and the surface is deeply indented on its northern edge with one

larger and two smaller shallow lagoon-sinks into which drain various seepages of fresh water, there being few springs and no streams on the land proper. The lagoons are bordered by typical mangrove associations. The ends of the crescentric or broad omega-shaped islands show transition formations between the continuous liku forest and the interrupted forest of the leeward shore. No outcroppings of volcanic rock were observed on Tongatabu, all rocks being calcareous (coral) formation covered by varying thicknesses of brownish soil.

The observations and materials of Hoffmeister and Parks on Eua indicate a plan of plant distribution similar to that of Tongatabu, modified by the greater height, steeper and higher liku cliffs, exposures of volcanic soils amid the limestone areas, more abrupt slope from liku to leeward, the presence of ravines, etc. The liku forest formations are similar on the two islands, but are proportionately more extensive and the associations are more complex, especially as to number and mixture of spices, on Eua. There are no lagoons on Eua and consequently no mangrove associations. The volcanic areas are bare or supporting a more or less scanty herbaceous formation. The ravines introduce elements lacking on Tongatabu and with seeming localization of distribution of certain species—a matter which needs further careful study.

The marine vegetation of the exposed shores is very different from that of the protected shores, the spumatophytes being more in evidence on the exposed shores and absent on the protected. During our stay summer annuals were absent, the temperature of the waters being below 25° C., dropping to 21°–22° C. much of the time. The Melobesieae, while abundant, were apparently not aiding much in reef formation and little seemed to be occurring in this direction. The rims of the basins of the lowest terrace or wave bench on the liku side were not observed as being formed of successive layers of nullipore as Lister[1] has indicated, nor is this "barrier" as he calls it, a sort of "nullipore mound," but both wave bench and basins seem to be due to unequal erosion of the general limestone mass forming the cliffs above it. No pavement nullipore surface was observed on any reef either of Tongatabu or of Eua. The fringing reef off Nukualofa seems dead since, although it is veneered by abundant coral growth on rim and just below the rim, there is very feeble cementation through nullipores.

The barrier reef off Suva in Fiji seems even more clearly dead (as a reef) and is being rapidly eroded on the surface by sea-urchin action, nullipore growth being very inadequate for preservation and expansion. The "reefs" at the entrance to Apia Harbor, on Upolu, seem to be in the transition stage between bank and reef, nullipore cementation being reasonably adequate, but no surface pavement of nullipore (*Porolithon onkodes*) as yet having been formed.

Of the floristics of southern Tonga, little can be said until the collections are critically studied. Most of the species attributed to Tongatabu and Eua were found and some additional are to be reported. This is particularly true of the marine flora. What seems to be a new genus of Melobesieae of striking honeycomb habit was prominent and abundant on the exposed liku shores of both Eua and Tongatabu. Both islands are the eastern limits of a number of Indo-Malayan as well as of Australio-Papuan species and genera.

BRIEF REPORT OF GEOLOGIC WORK

(By J. Edward Hoffmeister)

During our short stay in Suva, Fiji, the barrier reef in the harbor was studied and collections of corals made. A number of quarries in the vicinity of Suva were visited in collaboration with Dr. Harry S. Ladd, and material obtained which it is hoped will throw more light on the geologic age of the rocks.

The main geologic work was done on the island of Eua in the Tonga group. This important island lies about fifteen miles southeast of Tongatabu. It consists of a base of bedded volcanic tuff over which is a veneer of limestone. The island has been elevated so that at present it stands nearly one thousand feet above sea level. The volcanic base is exposed in many places on the high part of the island, which runs as a ridge in a nearly north-south direction. As elevation took place a series of well-developed terraces were formed which are most distinct on the eastern or liku side of the island.

Detailed work was done on the high ridge and the terraces to the east. The volcanic areas were mapped and also the extent of each terrace. Fossil corals are abundant on the seaward edge of the lower terraces; some were found on the higher terraces, but none on the highest. From a superficial study of the material found, the evidence points to the following possibilities:

(1) The highest part of the island is the oldest.

(2) Elevation has taken place with the formation of the terraces in comparatively recent times.

(3) The foraminiferal limestones which make up the high parts of the island and the inland edges of most of the terraces are older than the elevated coral reefs of the seaward edges.

(4) The elevated coral reefs were formed at the time of the formation of the terraces.

(5) Eua is the oldest Tongan island, and probably dates back to Tertiary times.

The present fringing reef at Nukualofa, on Tonga-

[1] *Quart. Journ. Geol. Soc.*, London, 47; 615, 1891.

tabu, was studied and comparisons made with the limestones of the interior. A brief time was spent in reconnaissance work on the island of Vavau to the north and also at Apia, western Samoa.

A detailed report of the geologic findings will appear as soon as the material has been carefully studied.

BRIEF REPORT OF MALACOLOGICAL WORK

(By J. M. Ostergaard)

During a period of about eight weeks, from July 1 to August 23, 1926, attention was given to the distribution and ecology of the marine Mollusca of the island of Tongatabu and neighboring islands and reefs, and to a comparison of these with those occurring in a fossil state in the limestone of which Tongatabu is composed.

The findings are: that many of the tropical species of the Pacific that occur in the warmer waters of Samoa and Fiji are rare or absent in the southern part of Tonga, while some such forms occur in a fossil state in the limestone of Tongatabu; and that among the recent species inhabiting the shore reefs is an abundance of such forms as occur in the same manner in Hawaii but which are scarce in the intervening warmer zone of the Pacific.

Deductions from these observations are that there was (possibly, in the Pleistocene), a southern expansion of the tropics in the Pacific similar to that of a northern expansion of the same period, so clearly evidenced by a comparison of the fossil marine Mollusca in the limestone of Oahu with those now living in Hawaiian waters.

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SCIENTIFIC EVENTS

THE AMERICAN SOLAR OBSERVATORY IN SOUTHWEST AFRICA

THE observatory to measure the heat of the sun established on the top of Mount Brukkaros in Southwest Africa by the National Geographic Society in cooperation with the Smithsonian Institution has been completed and the American observers are moving in.

Mr. A. Dryden, inspector of works under the government of Southwest Africa, with a corps of European and Hottentot laborers, has been at work on the observatory since Dr. Abbot, of the Smithsonian Institution, picked the site last March. The isolated position of Mount Brukkaros in the midst of a desert, the difficulties of getting men and materials up its rocky slopes, the heat and the scarcity of water have put so many obstacles in the way of the work that only the cordial cooperation of the British authorities could have made possible its completion so early.

The natural cave originally selected by Dr. Abbot for the observatory proper had to be abandoned due to the unsuitability of the mountain for tunnelling. A second site suffered the same fate after several hundred tons of loose rock had been removed. The third try proved successful. The site is located on the topmost ridge of the mountain.

To obtain water during the construction of the observatory, the engineers had to sink a well under the site of a dry waterfall. Two tanks excavated in the rocks with a capacity of 3,000 gallons each have been completed to catch the rare rainfall for the observers, but during the six months past no rain has fallen. However, the "rainy season" for Brukkaros occurs in February and March, when it is expected that a sufficient supply will be caught in the tanks to carry the observers through the long dry season. Until the rains come it will be necessary to haul water up on the backs of four small donkeys.

The postal authorities are erecting a special telephone wire connecting the observatory with the railway station at Tses. Over this wire the daily values for the sun's heat will be telephoned to Keetmanshoop and thence cabled to America. For the observers a special house some distance below the observatory inside the mountain has been constructed, while on the plain at the foot of the mountain a garage will house the truck by which supplies will come to them from civilization.

On this site and under these conditions the two American observers, Mr. William H. Hoover and Mr. Frederick Greeley, plan to spend the next three years.

GRANTS FROM THE LAURA SPELMAN ROCKEFELLER MEMORIAL

THE report of the Laura Spelman Rockefeller Memorial shows appropriations to the amount of $7,822,890 made during 1925 in the fields of the social sciences, child study, social work and public welfare.

Appropriations in the field of the social sciences included funds for research assistance, for books and periodicals and for international traveling fellowships. Appropriations were made to universities and other research agencies both in the United States and abroad. A total of $1,198,730 was voted for social science.

The research institutions aided during 1925 include Columbia University, $256,500 over a five-year period; University of Chicago, $61,500 over a three-year period; University of Denver, $37,500 over a five-year period; Economic Foundation, for the National Bureau of Economic Research, $20,000; Northwestern University, for the Institute for Research in Land Economics and Public Utilities, $10,000; Uni-