PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

FIFTH ANNUAL MEETING

MAY 1-3, 1930

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HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

During the year 1929-30, seven special public meetings of the Academy were held, at which addresses were delivered as follows.

Commander James P. Ault: The work of the non-magnetic yacht "Carnegie." (October 1, 1929.)

Dr. C. M. Yonge: The great barrier reef of Australia. (October 22, 1929.)

Dr. Royal N. Chapman: The trend of animal populations. (November 26, 1929.)

Dr. Frederick Wood Jones: Man's place among the lower animals. (December 17, 1929—a joint meeting with the Anthropological Club of Hawaii.)

Dr. Alexander Goetz: Recent studies in the physical structure of metals. (December 23, 1929.)

Dr. Robert E. Park: The mentality of mixed bloods. (January 15, 1930.)

Professor Douglas W. Johnson: The interpretation of shore-line scenery. (January 28, 1930.)

The sessions of the Fifth Annual Meeting were held at the Biology Building, University of Hawaii, May 1 to 3, 1930, ending with a banquet at the University Club.

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1929-1930

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PROGRAM OF THE FIFTH ANNUAL MEETING

THURSDAY, MAY 1, 7:30 P. M.

Preliminary announcements.
Election of members.
Appointment of committees.
Presentation of papers:
Dr. E. D. W. Brown: Polynesian leis.
Dr. Harold L. Lyon: The flora of Moanalua 100,000 years ago.
Mr. J. F. Voorhees: The distribution of rainfall on Hawaii.
Dr. Harold S. Palmer: Rock weathering in Hawaii.
Dr. T. A. Jaggar, Jr.: The Hualalai earthquake crisis of 1929.

FRIDAY, MAY 2, 7:30 P. M.

Presentation of papers:
Dr. Martha R. Jones: The acid-base balance of the blood in relation to dental decay.
Mr. T. M. Livesay: Reaction time experiments with certain racial groups.
Mr. H. A. Wadsworth: Plant and soil-moisture relations in Hawaii.
Dr. C. H. Edmondson: Some new Hawaiian Medusae.
Mr. Ray J. Baker: Biological records by means of the motion picture camera.

SATURDAY, MAY 3, 2:30 P. M.

Presentation of papers:
Dr. Harold St. John: The revegetation of a recent volcano.
Dr. Erling Christophersen: A few remarks on Joinvillea.
Dr. F. B. H. Brown: Notes on Marquesan monocotyledons.
Dr. E. D. W. Brown: Notes on Marquesan pteridophytes.
Dr. C. Montague Cooke, Jr.: Notes on Marquesan landshells.
Dr. G. P. Wilder: Observations on the flora of Rarotonga.

SATURDAY, MAY 3, 6:30 P. M.

University Club banquet.
Constitutional order of business.
Presidential address: The geologic history of Oahu.
Installation of new officers.
Adjournment.

ABSTRACTS OF PAPERS

THE GEOLOGIC HISTORY OF OAHU
(Presidential Address)

By

HAROLD S. PALMER

The only claim to novelty in the present paper is the method of presentation of some long known information. The underlying data are in part from my own observations on Oahu but in large part from the writings of others. The present paper is an attempt to meet the numerous requests that have come to me for an authentic but nontechnical history of the making of the island of Oahu.

About seven years ago, W. M. Davis published some small stereograms showing in a diagrammatic way three of the many stages in the history of Oahu. The corrections necessary to his stereograms result largely from the fact that they telescope into one stage several stages which might well be differentiated.

The island of Oahu is a "volcanic doublet," by which is meant that it has as the essential parts of its structure two volcanic domes. These were built at different times and have had their originally smooth surfaces modified on a large scale by the foundering of great segments and on a smaller scale, but in a more widespread way, by erosion. The erosion has for the most part been by streams which have furrowed the slopes with valleys of various shapes and sizes. In addition waves have cliffed some of the shorelines. Around the margins of the island there has been some addition of a veneer of sedimentary rocks over the lava core. The sedimentary veneer consists in part of calcareous reef rock deposited by corals, Lithothamnium, and associated marine organisms, and in part of stream-carried sediments laid down in quiet lagoon waters behind the reef or in sheltered bays. The geologic history is further complicated by the changes that have occurred in the relative elevations of land and sea.

The following stages are illustrated by the series of stereograms reproduced as lantern slides:

1. The initial stage, when lava flows had built a dome on sea bottom which, though nearly three miles high, was not high enough to reach above the surface of the ocean.

2. The nascent Waianae island stage, when the embryonic Waianae lava dome had first appeared above the surface of the ocean.

3. The adult Waianae island stage, when extrusion of lava had virtually ceased, after having built a rather symmetrical lava dome some 25 miles in diameter at sea level, and reaching 5000 or 6000 feet above sea level.

4. The downfaulted stage of Waianae island, when the southwestern one-third of the island had foundered because of the excessive weight which it applied to sea bottom.

5. The eroded stage of Waianae island, when a number of valleys had been cut into the smooth half-dome. The valleys of the southwestern side were more conspicuous because the steeper gradients there made the streams swifter and therefore better able to entrench themselves.

6. The Olomana and Kaaumakua islands stage, when two or more small islands had appeared above the sea to the northeast of the eroded Waianae island. These were twin embryos of the Koolau Mountains.

7. The adult Oahu stage, when the constructive volcanic processes had built Oahu to its maximum area and volume, by adding to the older Waianae island a dome of pear-shaped ground plan, 30 by 40 miles across at sea level and 5000 or 6000 feet high. The broad end of the pear was at the southeast.

8. The downfaulted Koolau stage, when the northeast part of the broad end of the pear-shaped lava dome had foundered because of its excessive weight.

9. The high level eroded stage, at the end of which Oahu had been cut by streams to much its present condition. An important difference, however, was that sea level (as shown by logs of wells in Honolulu) was a thousand feet or so lower, relative to the island, than it is now. As a consequence the valley forms extend far below the present sea level and far beyond the present shore line, though filled with sediment.

10. The submerged, reef building stage, when sea level was about 40 feet higher on Oahu than it is now. Along the shores at this time were fairly continuous fringing and barrier reefs, on and behind which sediments were laid down by streams. During this time occurred the last series of volcanic eruptions which built such craters as Makakilo and Palailai at the south end of the Waianae Mountains, and the Koko Head group of craters near or in Honolulu, and Ulupau Head and Moku Manu on the windward side.

11. The present stage, in which erosion is the chief geologic agent at work, and in which a recession of sea level has exposed the reefs.

A little west of Waialua one can see from a single viewpoint eight different types of geologic surfaces made by various geologic processes or combinations of processes. They are as follows:

1. Residual fragments of the original smooth constructional slopes of the Waianae dome.

2. Canyons and canyon walls cut in the lava rock by stream erosion.

3. A bold cliff, several hundred feet high, which truncates the seaward edges of the lava flows and of the original slope, and which was cut by the undermining action of waves.

4. Alluvial cones composed of sediments swept out of the canyons and laid down in front of the high sea cliff.

5. Small arroyos cut into the alluvial fan by stream erosion.

6. A second, much lower sea cliff which truncates the seaward edges of the alluvial fans and which was cut by wave erosion.

7. A coastal plain, largely underlain by reef rock and mantled with sediments washed from inland.

8. A bordering sand ridge, in part a dune ridge and in part wave built.

POLYNESIAN LEIS

By

ELIZABETH D. W. BROWN

Polynesian leis were discussed from the standpoint of motive, concept, origin, and age, in relation to each other and to the continental concepts as expressed in literature and art and in present religious practices in India and China.

THE FLORA OF MOANALUA 100,000 YEARS AGO

By

HAROLD L. LYON

A drainage tunnel being driven through one wall of Salt Lake crater at mean sea level reveals the remains of a forest that was buried in ash at the time this crater was formed some 100,000 years ago.

The ground surface on which this ancient forest stood approximated mean sea level of the present day, for the tunnel, which is six feet high, included the old forest floor with its fallen logs, twigs and leaves, which are now clearly imprinted in the tuff resulting through the solidification of the ash.

The rock removed in making this tunnel also included basal portions of the trunks of many trees which were buried in their natural upright positions. Most of the wood in these trunks has disappeared, leaving casts which retain the exact shape of the trees which they represent, there being no evidence of any crushing or distortion. A few specimens of completely silicified twigs and palm-leaf petioles have been found in which the cell structure can be clearly discerned. Perfectly preserved fibrous tissue was also found hermetically sealed in solid rock. From the materials collected, it will be possible to identify with absolute certainty some fifteen or more species of plants closely related to, if not identical with, species of the present day. At this time I shall name only koa, ohia and loulu as known components of this ancient forest. It was such a plant society as now occurs at the very head of the valley, on the backbone ridge of the Koolau Mountains.

Mr. Fred E. Harvey, who is the engineer in charge of the tunnel, recognized the nature of the fossils and called my attention to them in February of the present year. [Illustrated with specimens and charts.]

THE DISTRIBUTION OF RAINFALL ON HAWAII

By

J. F. Voorhees

The subject is considered from two points of view, the variations of rainfall with respect to area and with respect to time, or more briefly, the areal and the annual distribution of rainfall.

The areal distribution is shown by the ordinary isohyetal map of average annual rainfall, while the annual distribution is usually represented by a graph or diagram showing the average rainfall for each month for a given station or district. The map [shown as a lantern slide] presents both features, the isohyetal lines showing the areal distribution for the island of Hawaii and the diagrams showing the annual distribution for several places.

The average rainfall over the ocean in this part of the world is probably less than ten inches per annum. Where more than ten inches per year is recorded at any point on these islands the excess is due to the cooling of the air as it moves up the mountain slopes. Consequently, the heaviest rainfall is found on the windward side of the island. The rather heavy precipitation in the Kona section may seem to be an exception but really follows the rule, for the rain there is due to sea breezes coming from the ocean.

In the diagrams showing the distribution throughout the year great variety is seen. In fact, no two points have exactly the same distribution, although stations in the same locality are usually much alike. The differences are due mainly to differences in topography in relation to the winds. Sometimes the explanation of any given distribution is quite obvious, while in other cases the causes are very obscure. For example, the summer maximum in the Kona district is due to the fact that Kona gets most of its rain from sea breezes which are weak or entirely absent in the cooler half of the year. On the other hand I have no good explanation to offer for the summer maximum in the Kohala mountains.

In making comparisons of this kind it is important to bear in mind the fact that the average distribution for a period of 10 or 20 years may be and usually is very different from the average for 50 years. It should also be remembered that average values of rainfall are always too high, especially so in regions like this which are subject to occasional very heavy downpours. [Illustrated with slides.]

ROCK WEATHERING IN HAWAII

By

HAROLD S. PALMER

In 1912, W. P. Kelley published four pairs of analyses showing the chemical composition of the fresh unweathered cores and of the partly weathered shells of four basalt boulders from the Wahiawa district of Oahu. Examination of these analyses shows that aluminum, rather than titanium, is the most stable ingredient. On the confessedly arbitrary assumption that alumina is perfectly insoluble, it appears that between three-eighths and five-eighths of the titania and sulphur trioxide are removed; between five-eighths and seven-eighths of the phosphorus pentoxide, silica, ferrous oxide and potash are removed; between seven-eighths and fifteen-sixteenths of the manganous oxide and soda are removed, and about ninety-nine percent of the lime and magnesia. There is an actual six-fold gain of water and a seeming gain of ferric oxide of seventy percent, which is really due to the conversion of ferrous oxide to ferric oxide.

An analysis of water from Kalihi stream reports silica, ferric oxide, lime, magnesia, soda and potash in about the relative proportions in which they are seen to be lost on comparing Kelley's analyses. This is a fair check on the validity of the computations given above.

With the methods of computation used by petrographers it is possible to calculate the mineral composition of a rock from an analysis of the rock. Such calculations, when applied to Kelley's analyses, indicate that, of the mineral molecules in the fresh rock, rhodonite, clinoenstatite, wollastonite, iron metasilicate, magnetite, anorthite and noselite are completely destroyed. Albite and orthoclase are largely destroyed. Ilmenite and apatite are about two-thirds destroyed. Quartz suffers little. New minerals that appear are bauxite and limonite, which are abundantly formed, and rutile, mirabilite, gypsum, epsomite, gibbsite and psilomelane, which are formed in small quantities. [Illustrated by graphs and lantern slides.]

THE HUALALAI EARTHQUAKE CRISIS OF 1929

By

T. A. JAGGAR, JR.

Seismograms had been normal in Hawaii until sudden shaking began and continued in North Kona near Hualalai volcano September 19, 1929. The records at Kilauea station indicated average distances of epicenters for four weeks ending October 16 respectively 23, 28, 35 and 44 miles. Big earthquakes of grade IX R. F. occurred at Puuwaawaa September 25 and October 5 after hundreds of smaller shocks. The felt earthquakes had spread from

North Kona to the whole island, and these great ones were felt in Honolulu. From Kona to Kohala there was severe damage to masonry, water tanks, road fills, steep hillsides, chimneys, stone fences, and improperly braced wooden buildings. Airplane inspection revealed no volcanic outbreak. The shaking gradually quieted in November.

The number of shocks recorded at four stations during the period October 1-October 4, 1929, were as follows:

	Oct. 1	Oct. 2	Oct. 3	Oct. 4
Kilauea	19	13	15	18
Hilo	38	26	13	74
Kealakekua	155	110	96	138
Puuwaawaa	241	117	97	114

Hilo has more shocks than Kilauea, yet is farther from Hualalai.

The shock recorder at Puuwaawaa (Scientific American, Nov. 1929) registered shocks as follows:

September	26	599
	27	541
	28	400
	29	334
	30	321
October	1	241

The computed instrumental total for the 26 days (September 21 to October 6) at Puuwaawaa is approximately 6211 shocks, mostly perceptible to a person at rest. This averages 239 per day or 10 per hour.

The cataclysmal earthquakes of September 25 and October 5 showed no preliminary tremor on seismographs at Hilo, at Kealakekua, or at Kilauea. All behaved as though epicentral at distances 40 to 60 miles apart. The ordinary earthquakes showed preliminaries accordant with short distances by the Omori formula. Presumably the big shocks were very deep. [Illustrated with lantern slides.]

THE ACID-BASE BALANCE OF THE BLOOD IN RELATION TO DENTAL DECAY AND ALVEOLAR ATROPHY

By

MARTHA R. JONES

(In collaboration with N. P. Larsen and G. P. Pritchard)

Metabolic, blood, roentgenographic, and histologic studies on dogs showed that alkalosis induced by diets which were potentially alkaline in reaction was invariably associated with resorption of alveolar bone, cementum and dentin. Profound degenerative changes occurred also in the long bones of puppies. In no case was there decay of enamel. On the other hand, rampant disintegration of the crowns of the teeth, called odontoclasia, occurred in 70 per cent of the puppies who were in a highly active state of calcification (recovery from rickets) during the period of eruption of their permanent teeth. The activity of the decay process was usually of short duration (three or four weeks), and appeared to bear a relation to the rate of calcification of the skeleton bones.

Rickets in children in Hawaii is rare. Evidence indicates, however, that bone and tooth development during the first months of life is subnormal in many cases. Later, rapid calcification of the skeletal bones is stimulated by outdoor life and abundance of sunshine. Concomitant with the spurt in bone growth, rampant disintegration of the newly erupted teeth frequently occurs. The decay process, after a period of more or less intense activity, may then be arrested, and crowns of teeth which are mere stumps of dentin remain intact indefinitely.

Evidence indicates that decay of enamel and resorption of alveolar bone and the root of the tooth are the result, primarily, of systemic disorders, and that they do not occur concomitantly. Dental decay and rapid bone growth apparently occur when the imbalance in the tissue lymph and oral secretions is toward the acid side, lactic acid formed on the surface of the tooth by bacteria thus being left free to combine with the calcium in the tooth substance. When basic elements are present in certain amounts or in excess in the body fluids, the lactic acid thus formed in the mouth can be neutralized and dental decay is not only prevented, but partially disintegrated enamel and dentin actually become more dense. Beyond certain limits, bone atrophy begins. Breast milk, cod liver oil and sunshine, which increase the acidity of the intestinal contents of rickety infants and promote bone growth, do not prevent odontoclasia under the conditions mentioned. Diets which yield an alkaline ash (fruits and vegetables in excess) were found to be invariably associated with sound tooth structure or arrested decay.

Experimental and clinical findings agree in great detail. They support Bodecker's theory of the mechanism of dental caries and offer a logical explanation of many phenomena which have long been recognized but not understood. [Illustrated with lantern slides.]

REACTION TIME EXPERIMENTS WITH CERTAIN RACIAL GROUPS

By

T. M. Livesay

(In collaboration with C. M. Louttit)

The aim of this project was two-fold: (1) to ascertain the differences in reaction time performances between racial groups; and (2) to determine the relation between reaction time performance and intelligence.

The reaction time measurements were made on a standard "Marietta reaction time set," and in order to insure uniformity of procedure, all measurements were made by the same person. Readings were taken for visual, auditory and visual-choice reaction times.

The measure of intelligence was the Thorndike "Intelligence examination for high school graduates." Scores on this test were available for 253 students who had entered the University of Hawaii one, two and three years previously.

The students who took part in the experiments numbered 286; 59 Caucasian (14 men and 45 women); 71 Chinese (29 men and 42 women); 110 Japanese (69 men and 41 women); and 46 Part-Hawaiian (15 men and 31 women).

The results were as follows: (1) the reaction time differences between the average performances of the several racial groups were consistently low and insignificant; (2) the sex differences in reaction time, while low, were somewhat greater than those for race, and in all comparisons the males excelled the females; (3) the correlation coefficients between the reaction times and intelligence, while positive in all cases, were too low to be of any significance. [Illustrated with charts and apparatus.]

PLANT AND SOIL-MOISTURE RELATIONS IN HAWAII

By

H. A. Wadsworth

Modern investigations of the relations between soils and soil-moisture have modified the conceptions of only a few years ago. The soil mulch is no longer credited with the power of conserving soil-moisture if weeds are removed, and the significance of capillary movement of moisture from relatively wet areas to dry areas has been greatly minimized.

For several years much attention has been directed toward the determination of two of the critical soil-moisture constants for important agricultural soils. These are the maximum water holding capacity and the wilting coefficient, the latter being the minimum percentage of water in a soil which will provide moisture to the roots of growing plants at a rate great enough to maintain normal turgor in these plants. It is interesting to note that the wilting coefficient depends entirely upon the soil and not upon the plant, all plants wilting, or giving some sign of physiological disturbance, at the same moisture content provided the soil used is the same for all.

Hawaiian soils are peculiar in both these critical moisture contents. After irrigation they hold high percentages of water; when wilt occurs they still hold more moisture than most mainland agricultural soils do immediately after a heavy rain. The reason for these peculiarities is not known and deserves study.

Sugar cane and pineapples exhibit wilt, not by apparent loss of turgidity, but by evidence of physiological abnormalities which are probably caused by lack of readily available moisture. In the sugar cane, length growth ceases when soil-moisture is reduced to the wilting coefficient, while in the pineapple, the transpiration rate is abruptly reduced. In each case this disturbance occurs at a soil-moisture content which is significantly close to the wilting coefficient as determined for the soil in question by other plants. [Illustrated with charts.]

NEW HAWAIIAN MEDUSAE

By

CHARLES H. EDMONDSON

Creeping medusae are recorded from the North Pacific Ocean for the first time. The four species of *Eleutheria* found on the reefs of Oahu all seem to be new. Lengerich (1923) recognizes three species of this genus adapted for creeping, two from the coasts of Europe and one ranging through the southern hemisphere from the Antarctic as far north as Port Jackson, Australia. The Hawaiian species differ from these in several critical characters, and are referred to as *Eluetheria oahuensis,* new species; *E. alternata,* new species; *E. acuminata,* new species; and *E. bilateralis,* new species. These four species are all minute, the diameter of the umbrella ranging from 0.5 to 0.8 mm.

A new sessile medusa of the genus *Kishinouyea* is recorded, referred to as *K. hawaiiensis,* new species. This is the first record of this genus from subtropical waters, previously known species having been reported from cold latitudes only. [Illustrated by lantern slides.]

This paper is to be published in full by Bernice P. Bishop Museum.

BIOLOGICAL RECORDS BY MEANS OF THE MOTION PICTURE CAMERA

By

RAY J. BAKER

There is nothing new about the idea of using the motion picture camera for the keeping of biological records. Both American and European workers have made use of this instrument for many years. The increased use of films for educational purposes has, however, given much greater interest to this form of record. A characteristic of living things is that they move, and a record of movement is of the greatest value to the biologist. By means of the interval camera it is possible not only to show movement not usually perceptible to the eye, but also to condense the time so that action requiring hours or even days to complete may be shown on the screen in a few minutes. [To illustrate the use of the motion picture camera, lantern slides of both still and motion picture equipment were shown. The film scenes illustrated cup of gold, hibiscus, spider lily, praying mantis, termites, carpenter bee, mosquito larvae, and surf fish.]

THE REVEGETATION OF A RECENT VOLCANO

By

HAROLD ST. JOHN

Mt. St. Helens is a volcanic peak 9671 feet high, in the southern Cascade Mountains of Washington. At the present time its crater is filled with snow, yet a steam vent indicates warmth not far below.

Violent eruptions were recorded several times between 1830 and 1845. Extensive aa flows on the south side are partially forested. Pahoehoe flows on the north side are practically bare. Tree casts in these basalts indicate a pre-existing large forest, 90 years ago.

All the other slopes and the cone are covered with 40 feet of loose pumice. They show abundant tree casts, one every few feet near Spirit Lake. There, on the surface, another forest has become established. One tree, a Noble Fir, died of old age in 1924. It had 335 annual rings. Hence, the pumice layer is much older than the basalt. Yet the vegetation of this mountain is different from that of surrounding mountains. The Noble Fir is abundant. The dominant tree at and near the tree-line is *Pinus contorta* var. *latifolia,* not found elsewhere above the Canadian Zone.

The rainfall and snowfall are ample, but the pumice layer is so loose and porous that all streams are subterranean, except where they are forced to the surface by a rock ledge.

Adjacent mountains have abundant meadows, non-xerophytic vegetation, and a tree line at 5500 to 7000 feet. Due to perfect subdrainage through the pumice, Mt. St. Helens lacks meadows, has a pronounced xerophytic flora, and the tree-line is at 3500 feet. Revegetation is very slow. [Illustrated by lantern slides.]

A FEW REMARKS ON JOINVILLEA

By

ERLING CHRISTOPHERSEN

Joinvillea elegans and *J. adscendens* (Flagellariaceae) are pictured by Gaudichaud in the botanical atlas of the voyage of the "Bonite," plates 39 and 40, without descriptive text or notation as to locality. *J. elegans,* represented in great detail from a fruiting specimen, has not been collected since in the Hawaiian islands, if it was ever collected here, and *J. adscendens,* represented by a sterile twig with young leaves only, can not be identified with certainty, although it is generally attributed to these islands. Gaudichaud's original specimens have been lost, as were the records of locality. In view of these facts, certain changes in the nomenclature are proposed, to be published at a later date. [Illustrated with lantern slides.]

NOTES ON THE MARQUESAN MONOCOTYLEDONS

By

F. B. H. BROWN

The indigenous monocotyledons of the Marquesas Islands are allied primarily with those of the Society Islands, and secondarily with those of Hawaii.

The degree of endemism indicates that the age of the Marquesas Islands is approximately the same as that of Tahiti, but considerably younger than Hawaii.

It is clearly shown that litoral vegetation is not cosmopolitan in distribution; on the contrary, its percentage of endemism is nearly as high as that of the upland vegetation.

The non-indigenous species and varieties outnumber the indigenous ones; they are composed mostly of species of aboriginal introduction and varieties derived by native cultivation, showing how profoundly the vegetation of these islands has been modified by the early inhabitants.

NOTES ON MARQUESAN PTERIDOPHYTES

By

ELIZABETH D. W. BROWN

In the study of the fern flora of the Marquesas and its affinities with neighboring island groups, the following facts have proven of extreme interest and have an important bearing upon plant distribution in eastern Polynesia:

1. There is a surprisingly high percentage of endemism considering that the spores are seemingly well adapted to wind distribution.

2. The affinities are primarily with the Society Islands and secondarily with Hawaii. The percentages compare so closely with those of the monocotyledons as to suggest that they have followed nearly the same routes of migration as the monocotyledons and may therefore have been carried by the same agencies of dispersal.

The evidence does not favor the conclusion that wind has been a prominent agency in the wide dispersal of pteridophytes in this region.

NOTES ON MARQUESAN LANDSHELLS

By

C. Montague Cooke, Jr.

Little attention has been paid to the landshell fauna of the Marquesas Islands up to the present. Probably much less than half of the species that inhabit these islands have been collected. With the rapid destruction of the native vegetation the land faunas are disappearing and intensive collecting should be begun immediately if anything is to be learned of this interesting fauna.

At present species of 21 genera belonging to 11 families are known: of these genera only 8 are represented by endemic species; 3 have doubtfully endemic species; and the representatives of the 10 remaining genera were undoubtedly accidentally introduced by man, chiefly by early Polynesians. About 75 per cent of these species are endemic and limited in their distribution to the Marquesas Islands, and about 90 per cent of these are known only from single islands.

Seven of the eight genera with endemic species show a fairly high degree of specialization which can only be accounted for by a rather long period of isolation. The more or less even development of specific differentiation in most of these genera seems to indicate that they came to the Marquesas during a single period of time; and since a number of more specialized genera occurring on the nearest groups of islands are absent from here, it is likely that further migrations have not taken place until man came to these islands.

SOME OBSERVATIONS ON THE FLORA OF RAROTONGA

By

GERRIT P. WILDER

Rarotonga, the principal island of the Cook group, lies in the same latitude and longitude south of the Equator that Hawaii lies north of it, and their climatic conditions are practically the same. For these reasons, a comparative study of their floras is interesting.

Rarotonga is of volcanic origin. It is irregularly elliptical in shape, roughly 7 miles long by 5 miles wide, and is surrounded by a coral reef. From the comparatively narrow stretch of flat land encircling the island at sea level, hills begin to rise, gradually becoming more and more precipitous until the peaks of the mountain ranges are reached. The tallest of these, Te Manga, is about 2220 feet high. Deep valleys and steep ravines lead streams to the sea, and an annual rainfall of about 90 inches keeps the valleys and hillsides green and heavily wooded. Thus Rarotonga, in its physical aspects, resembles Hawaii, and its zones and elevations yield much the same species of plants as are found in Hawaii.

During my three visits to Rarotonga, I have selected from among the wealth of rare plants growing there certain ones which will be valuable additions to the flora of the Hawaiian islands. These have been successfully introduced into the Territory, and are now thriving. Among them may be mentioned: *Angiopteris evecta,* a tree fern with fronds 15 to 25 feet in length, the fragrant young leaflets of which are often woven into garlands and wreaths for personal adornment; *Alphitonia ziziyphoides,* a stately forest tree with a straight trunk and spreading branches, dark colored and very hard wood, formerly used for spears and agricultural tools—a tree that bears quantities of seed and should be a useful tree in Hawaiian forests; *Elaeocarpus rarotongensis,* another hardwood forest tree, the bright blue fruits of which, each containing a single seed, hang in great bunches from the terminal branches; *Fitchia speciosa,* a symmetrical medium-sized tree with glossy leaves, and with large yellow flowers that contain an abundance of nectar; and *Inga preussii,* a large tree bearing a bean one to two feet in length, the seeds of which, an inch in diameter, are surrounded by an edible pulp. [Illustrated by lantern slides.]

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