PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

SIXTH ANNUAL MEETING

APRIL 30—MAY 2, 1931

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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 1930-1931, three special public meetings of the Academy were held, at which addresses were delivered as follows:

Dr. Charles A. Kofoid: Easter Island. (September 16, 1930.)

Dr. Peter H. Buck: Practical uses of anthropology. (January 15, 1931.) A joint meeting with the Anthropological Club of Hawaii.

Dr. Julius L. Collins: Effect of radium on living, growing cells. (April 20, 1931.) A lecture in connection with a showing of the famous Canti film, obtained through the cooperation of the University of Hawaii Extension Division.

The sessions of the Sixth Annual Meeting were held at the Biology Building, University of Hawaii, April 30 to May 2, 1931, ending with a banquet at the Pacific Club.

OFFICERS

1930-1931

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PROGRAM OF THE SIXTH ANNUAL MEETING

THURSDAY, APRIL 30, 7:30 P. M.

Preliminary announcements.
Election of members.
Appointment of committees.
Presentation of papers:
Mr. J. F. Voorhees: Is the average rainfall the most probable rainfall? and The average rainfall in the Honolulu district.
Dr. Madorah E. Smith: Is the oriental or English direction of reading the more natural?
Dr. John Wesley Coulter: The distribution of population and land utilization in the Hawaiian islands in 1853.
Dr. Tokue Takahashi: About the discharge of mercury arc lamps.
Dr. T. A. Jaggar, Jr.: Niuafoou volcano in Tonga; its eruptions and its people.

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

Presentation of papers:
Dr. C. H. Edmondson: Asexual reproduction in sponges.
Miss B. H. Krauss and Dr. C. P. Sideris: The physiological role of titanium in the development of chlorophyll.
Dr. C. P. Sideris and Miss B. H. Krauss: The effect of different iron concentrations on the growth and metabolism of plants.
Dr. Christopher J. Hamre: The influence of iodine upon the development of the thyroid of trout (*Salmo fario*).
Mr. E. H. Bryan, Jr.: Kahoolawe, the island of dust.
Mr. Ray J. Baker: Biological records by means of the motion picture camera.

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

Presentation of papers:
Mr. D. M. Weller: The sugar cane plant: root pressure and root pressure liquids.
Dr. C. Montague Cooke, Jr.: Evidences of climatic changes in the Hawaiian islands. (Read by title.)
Dr. E. D. W. Brown: Pteridophyta of southeastern Polynesia.
Dr. Oscar W. Allen: Characteristic properties of the virus of fowl-pox.
Mr. Charles S. Judd: Botanical bonanzas.

SATURDAY, MAY 2, 6:45 P. M.

Pacific Club banquet.
Constitutional order of business.
Presidential address: Revolution in Hawaiian culture.
Installation of new officers.
Adjournment.

ABSTRACTS OF PAPERS

REVOLUTION IN HAWAIIAN CULTURE

(Presidential Address)

By

EDWARD S. C. HANDY

The Kapu

The *kapu* was the principle of integration of the old Hawaiian culture. *Kapu* is defined as "regulation of living according to psychic law," or "discipline by imminent supernormal agency."

Social classes

The ancient society was a caste system, with *kapu* regulating the relationship and respective functioning of the three castes: *alii* (sacred chiefs), *maka-ainana* (commoners), and *kauwa* (outcasts).

The Family

The ancient Hawaiian family was motivated and regulated in accordance with the prevailing Polynesian principle of the sanctity (*kapu*) of the male and the commonness (*noa*) of the female. This principle of sex classifications rather than incest prohibitions like those common to most peoples, regulated personal and marital relationships. Terms of relationship reflect the sex classification. Economic and domestic functions were based on it: males segregated themselves for cooking, eating, working. Females had their separate places for eating, natural functions connected with reproduction, and industries. The father was priest for the family gods. Women had their separate patron spirits.

The Nation

The *Mo-i* (Supreme) or Sacred King, was the pivot of the government and of the social order. His succession to the title and his authority and religious and social functions arose out of his purity of blood and direct descent from the gods. He regarded himself as an incarnate god (*akua*), and priests and people revered him as such. All land belonged to the *Mo-i*, and every new *Mo-i* upon accession reallotted districts and estates to relatives and loyal supporters, who in turn allotted holdings and rights to farmers and fishermen. Administration was under the *Kalaimoku* (Island-cutter), a man of either noble or common birth, loyal, experienced and sagacious; he was termed the "Back-bone" (*Kua-mo'o*) of the King. Civil administration, diplomacy and war were under the *Kalaimoku*. The *Konohikis*, or land

supervisors and tax assessors, were under him. The priests of the temples of Ku, the war lord, and Lono, the god of peace and agriculture, represented a second "party" in government that influenced and abetted or restrained the *Mo-i*. The *Mo-i* was the ultimate court of appeal in matters of justice.

In peace time, and during the great agricultural harvest festival, the Sacred King was the symbol and embodiment of Lono, god of rain and patron of agriculture. In the drama of the annual harvest festival (*Makahiki*), the *Mo-i* played the chief role, assisted by priests of Lono. The sacred *Hula* was a form of magic to induce fertility in *Mo-i* and in the land, to cause rain and plenty. The harvest offerings were not mere taxes, but part of an elaborated magical cult to increase bounty: the farmer and fisher expected Earth and Sky to return with interest what was demanded of him as tribute during the festival. When he had made his harvest offering, there followed a long period of festivity, no work, feasting, dancing, sports, and the pageantry of the sacred drama of Lono. "The *Mo-i* was the life of the land," says an old chant. The *Mo-i* was the rallying point for the people, the *Makahiki* was the rallying time.

Again, in war time, the *Mo-i* was pivotal. In the elaborate ceremonial of dedicating a new effigy to the war lord and consecrating his temple (*Luakini*), the *Mo-i* played the central role, assisted by priests of Ku. The campaign was planned by the *Mo-i* with the assistance of his *Kalaimoku*. Every man raised to be a *Mo-i* was trained from infancy in the art of war and offence and defence, both personal and military. The *Mo-i* was, therefore, actually inspirer and leader, in preparations and on the field of battle, where he fought in the midst of his men arrayed in brilliant feather helmet and cape, surrounded by his family similarly arrayed, and by the feather symbols of his gods, borne by attendants and priests. The *Mo-i* was, then, in peace and war, the pivot of the social order, whose prestige rested upon *kapu*. In him the folk concentrated their intense devotion, upon his leadership and inspiration they were utterly dependent.

Industry

In industry, *kapu* was the regulating principle. Labor was consecrational; materials, workers, places, tools, the object being made were *kapu* during construction; fishing was consecrational, and planting likewise. In house building, in canoe building, in fishing, in planting, the common man was dependent upon the leadership of experts whose technical knowledge and ceremonial functioning represented a body of tradition passed on through systematic apprenticeship. This was true also of medical practice, witchcraft, and so on. The *kahuna*, then, or expert professional, was pivotal in the industrial life.

Abolition of the Kapu

Kamehameha united the islands under one rule, thus preparing the way for the abolition of the *kapu,* which could certainly never have been achieved by edict under the ancient system of divided rule under many *Mo-i.*

Kamehameha died in 1819, and chiefly through the instrumentality of the chiefess Kaahumanu, his dissipated son Liholiho abolished the *kapu* almost immediately after his accession to the *Mo-i* title. As Alexander puts it, "The effect of it was like that of displacing the keystone of an arch. The whole structure both of idol-worship and the tabus fell at once into ruins. The high-priest (Hewahewa) himself set the example of setting fire to the idols and their sanctuaries, and messengers were sent even as far as Kauai to proclaim the abolition of the tabus, which was termed *ai-noa* or free eating, in opposition to the *ai kapu.*"

In a word, the *Mo-i* and chief *kahuna* at a stroke swept away the principle upon which they stood. In principle, they abolished their respective roles, and at the same time the principle of discipline and integration of the native social order, and the social and industrial pivots upon which the commoner was, to a degree difficult for us to imagine, dependent.

What did this do to the individual Hawaiian? After 1820 it was at least a generation before the better influences of Euro-American civilization even began to take root in the life of the masses.

A picture is drawn of the condition of cultural deprivation and demoralization that must have prevailed as a result of the revolution or abolition of the *kapu,* in the two decades following 1820: the effect on family life, relations between the sexes, the withdrawal of leadership of *Mo-i* and *kahuna* in relation to planting, war, fishing, boat and house building; the effect on children born at that time; the psychological condition; confusion, troubled mentality, slackness, uncertainty; so that the mind of the individual and the whole social body must have suffered. At the same time, while divested of every stabilizing influence of his own cultural heritage, the native was subjected to the worst possible influences brought by seafaring men and adventurers from America and Europe.

While the Hawaiian cultural revolution was more dramatic than that elsewhere, it was by no means exceptional. The same revolution has taken place, in some cases with even more devastating results, practically throughout Polynesia. The more radical youthful leaders in China, India and elsewhere are in many cases bent upon bringing about such a cultural revolution and abandoning their own heritage in favor of western ways.

The question is posed: does the history of the Hawaiian people and of the Polynesians indicate that revolution, or abandonment of cultural heritage, is wise? Or is evolution, meaning transformation to meet new conditions, preferable?

IS THE AVERAGE RAINFALL THE MOST PROBABLE RAINFALL?

By
J. F. VOORHEES

Everyone understands that in any agricultural project the water supply is one of the essential factors. This is true whether we depend on the rain falling where it is needed, or at some point from which it may be brought.

Modern times and conditions have added a new problem. In these days when everyone is trying to attain godliness by the water route it takes more water to meet the necessities of one person than it formerly took to meet the needs of a large family. The result is that our great and growing cities are reaching out for greater and greater supplies of water. In almost every case this water supply must come from a limited area and as a result the study of the most probable rainfall is becoming more and more important, as the demand approaches the supply.

Any study of a long rainfall record reveals the fact that there are more years when the rainfall is below the average than there are when it is above the average. As an example, take the record for the month of February at the Weather Bureau in Honolulu. The average rainfall for 53 years is 3.63 inches. February was below that amount 38 times in the 53 years and above it only 15 times. One February had 24.93 inches or slightly more than the combined total of the 26 driest Februaries which amounted to 24.78 inches.

It is suggested that the median or middle value for any month for which we have a long record would more nearly represent the probable rainfall than does the average. [Illustrated with charts, including a map showing the rainfall distribution for the Honolulu district.]

READING DIRECTION AND THE EFFECT OF FOREIGN LANGUAGE SCHOOL ATTENDANCE ON LEARNING TO READ

By
MADORAH E. SMITH

This study endeavored to discover which direction of reading (Chinese or English) is the more natural to the young child and what effect the study at the same time of another language written in a different direction is upon learning to read English.

A picture-naming test was devised for this purpose that was applicable to young children and which has a high correlation with the older individual's preferred reading direction. The youngest children begin at the lower right-hand corner of the page most frequently. Children of four and five show a marked tendency to follow the edge of the page filling up the center last. Those who can read follow the order most similar to the language they read most. The return movement of the eye to the line below or column

next rather than reversing the direction on the next line or column is a more frequent procedure with readers than with non-readers. Children who could read scored higher on the test than those just beginning to learn to read.

Children attending foreign language schools, when paired on intelligence tests with other Orientals not attending foreign language schools, showed greater variability on the reading direction test, fewer English direction patterns being used and fewer perfect scores being made. They scored lower on every one of the five reading tests used. An analysis of the errors made by them showed a markedly higher number of errors in the recognition of letters and words that differ in orientation indicating a greater confusion of orientation in reading than among children attending but one school.

The study suggests that children may not be so disturbed by the different reading directions if they would not enter both schools at the same time and that it would be well for teachers to pay specific attention to teaching the approved reading direction and to words and letters easily confused in orientation. [Illustrated with charts.]

THE DISTRIBUTION OF POPULATION AND LAND UTILIZATION IN THE HAWAIIAN ISLANDS IN 1853

By

JOHN W. COULTER

Among considerations which make 1853 a good year in which to determine accurately the distribution of population in the Hawaiian islands are: 1, that was the first year for which a census report of the islands by districts is available; 2, at that time the people were settled permanently on the lands to which they had received title after the great *mahele*. The total population was 73,138 of which 2,119 were foreigners. Among the sources of information for land utilization in the islands in that year are: 1, official lists of exports from the islands; 2, accounts of travellers; 3, research publications; 4, "kamaainas" in the territory. There was a close relationship between the distribution of people on each inhabited island and the location of food crops and the supply of fish in offshore waters. Nearly all the people lived on or near the coast. Agriculture was an adjustment to a climate which, at sea level, is characterized by a low annual, monthly, and daily temperature range, absence of frost, and a moderate to heavy rainfall with striking contrasts in the amount of precipitation for areas at different altitudes and with different exposures to the prevailing trade winds; and to a relief which restricted most of the arable land to coastal plains and river deltas. Some of the more important uses to which the land was put were the raising of wet land taro, dry land taro, yams, sweet potatoes, bananas, and breadfruit. Sugar cane, coffee, corn, wheat, and Irish potatoes were also raised. Pastoral

activities were carried on mainly on higher lands. Honolulu and Lahaina, ports of call for whaling vessels, were the larger urban centers in the islands. [Illustrated with maps and slides.]

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

OBSERVATIONS ON THE DISCHARGE OF MERCURY ARC LAMPS

By
TOKUE TAKAHASHI

To overcome certain variations in the spectrum of the light emitted by quartz mercury lamps, a lamp provided with a plane quartz window was made. With this lamp the difference of intensities of radiations, both in the periphery and in the center of the discharge, was demonstrated by a pinhole photograph.

Spectroscopic examinations showed there were variations of spectra obtained from the different positions of the discharge. A band spectrum was described and shown, which begins with a sharp edge near 2537 and ends diffusedly in the region of visible rays. It was found that the band spectrum was shown most strongly by the light from the periphery of the discharge. It is possibly the same spectrum which was claimed to have been observed first by Lord Rayleigh, though he obtained it in a different way.

The ordinary spectrum of mercury lamps appears to consist of a line spectrum, superimposed on which is a band spectrum characteristic of the light from the periphery of the discharge. [Illustrated with slides.]

NIUAFOOU VOLCANO IN TONGA: ITS ERUPTIONS AND ITS PEOPLE

By
T. A. JAGGAR, JR.

Niuafoou, an active volcanic island belonging to Tonga, stands on the northeastern corner of the submerged portion of the Australian continent between Samoa and Fiji. It lies 15.5 degrees south of the Equator. It is almost a perfect ring five miles across, with a lake of brackish water three miles in diameter surrounded by a ridge 600 feet high. This is much like Crater Lake in Oregon. The whole island is covered with coconut palms and other verdure and most of the people live in nine villages on an outer lava platform surrounding the ring ridge.

The people are Polynesians with a civilization much like that of Samoa, and they are strictly governed by a high chief, a magistrate, and a police service representing the Queen of Tonga. There are usually seven or eight white people at Angaha, the principal port, where a rough landing may be made with boats. The people are completely Christianized, members of three

denominations, and are constant church attendants and lovers of religious music. The population is about 1,100, there are several motor cars, the trails are broad, and lovely avenues encircle the island amid coconuts, ironwoods, mangoes, pandanus, and plantations of yam, taro, papaias, sweet potatoes, bananas, and manioc.

There have been numerous lava eruptions in the 19th and 20th centuries at average intervals of 16 years. There were explosive eruptions through the central lake region in 1814 and 1886. A lava outbreak producing feldspar basalt took place July 25, 1929, along a concentric rift along the outer lava platform on the west side of the island. Numerous flows poured into the sea in the course of a few hours, coconut groves were invaded and thousands of tree molds were formed, cones were built up along the rift, and the village of Futu was destroyed. No lives were lost. This eruption was typical of what has occurred repeatedly on the west side of the island. The explosive eruption of 1886 produced no loss of life, but sent up cauliflower clouds, dropped about 2.5 feet of ash on the settlements, and piled up new cinder hills at one side of the lake, shutting off lateral lagoons. Earthquakes occur at times of eruption in Niuafoou, but tests with a shock-recorder in 1930, a year after the 1929 eruption, revealed seismic quiet.

The writer was privileged to make his map and exploration as a member of the Eclipse Expedition of the United States Naval Observatory under Commander C. H. J. Keppler. His volcanologic report will be published by the United States Geological Survey. [Illustrated with lantern slides.]

ASEXUAL REPRODUCTION IN SPONGES

By
CHARLES H. EDMONDSON

It is assumed that most species of marine sponges normally reproduce by the sexual process, but, like other animals of simple organization, asexual methods of reproduction may be employed when necessary. Among marine sponges there are occasionally seen phenomena which seem to parallel the gemmule formation of many fresh-water species.

An undetermined but familiar sponge in the shallow waters of Hawaii is a small hemispherical colony about one inch in diameter, white with a yellowish tint. On subjection to abnormal conditions in the laboratory, remarkable morphological changes occur. Processes of several kinds are protruded from the body. Some of these are long and filamentous, in length two to three times the diameter of the colony, others are short and club-shaped, and still others assume stellate forms with long, slender rays. All processes consist of an axial core of spicules surrounded by cells of a uniform type, amoeboid and highly granular.

The stellate bodies detach themselves from the parent sponge and, when confined in a stender dish, coalesce, finally producing a contracted spherical mass which develops into a new sponge. I have not observed the filamentous or club-shaped masses detaching themselves, but if severed from the colony each contracts into a spheroidal mass becoming potentially an embryonic sponge. Experimental work by other investigators indicates that similar bodies may be produced from sponge colonies as a result of foul water, low temperatures, overfeeding, or a lack of calcium.

It is known that in some low organisms somatic cells, violently disassociated from the body, will reassemble in clumps or aggregations, each mass becoming a regenerative body capable of developing into a new organism. Many Hawaiian sponges will thus form aggregations. Among the disassociated cells two general forms are recognizable: large, granular, amoeboid cells and small vibratile ones bearing collars and flagellae. Various investigators agree that the amoeboid cells absorb the flagellate cells as aggregations are formed and then pass into a generalized state comparable to a mass of blastomeres, in which growth and differentiation later occur. These aggregations are apparently comparable, physiologically, to the stellate masses formed from the body of the sponge under abnormal conditions. [Illustrated with slides.]

THE PHYSIOLOGICAL ROLE OF TITANIUM IN THE DEVELOPMENT OF CHLOROPHYLL

By

B. H. KRAUSS and C. P. SIDERIS

(Presented by Miss Beatrice H. Krauss)

The authors found that titanium could stimulate the development of chlorophyll in pineapple plants. Pineapple seedlings grown in nutrient solutions complete except for iron became chlorotic in two months. Titanium then added at the rate of 5 p.p.m. to the nutrient solution caused the plants to green up and grow as well as plants to which iron had been added in the same way. This stimulus over chlorotic check plants continued for eight months, when they again became chlorotic. Upon the addition, however, of 1 p.p.m. of iron the plants again became green and grew well. Check plants receiving 1 p.p.m. of iron alone remained chlorotic and did not grow.

The experiment repeated with the faster growing plants of corn gave some stimulus but not as marked as in the case of the slower growing pineapple plants.

The explanation offered for the physiological role of titanium in the development of chlorophyll is that the titanium reduces the oxidized iron (which becomes oxidized during the photosynthetic process and is thus made unavailable) in the ferric form to the available ferrous form. When iron occurs

in very low concentrations, titanium makes it available over and over again through repeated reduction of its oxidized forms. This titanium stimulus becomes very pronounced with slow growing plants where the photosynthetic process is slower and less iron is necessary. In faster growing plants where more iron is needed the role of titanium is necessarily reduced.

THE EFFECT OF DIFFERENT IRON CONCENTRATIONS ON THE GROWTH AND METABOLISM OF PLANTS

By

C. P. Sideris and B. H. Krauss

(Presented by Dr. C. P. Sideris)

Iron through its direct influence on the development of chlorophyll may favor or inhibit plant growth.

We have found through a series of experiments that different concentrations of iron cause profound physiological changes in plants. They may influence (1) the amount of chlorophyll produced per unit area of leaf tissues; (2) the amount of sugars produced by such tissues; (3) the assimilation of nitrates and (4) the absorption of such elements as potassium, calcium, etc.

Plant growth and the concentration of chlorophyll and sugars increases with increments of iron. The maximum for growth and chlorophyll production is between 14 and 28 p.p.m. of iron but that of sugars was found to increase even beyond 28 p.p.m. of iron.

The form in which the nitrogen is furnished to plants influences tremendously the iron requirements of plants. It has been found that plants receiving ammonium sulphate as their source of nitrogen are able to grow well in as low as 1 p.p.m. concentrations of iron, whereas similar plants receiving their nitrogen in the form of potassium nitrate require at least 15 times as much iron to grow equally well.

The concentration of the water soluble iron of all our culture solutions has never been found higher than 3 p.p.m. Hence, the increased rate of growth was due to that portion of the insoluble iron which had been extracted by the roots of our plants.

Plants grown in low iron concentrations contain more nitrates because they are unable to assimilate them on account of the low chlorophyll content of the leaves. The quantities of such elements as potassium and calcium are greater in the low iron concentrations on account of the low growth rate of the plants.

These results indicate that absorption of inorganic salts by plants is primarily a function of time modified doubtless by environmental conditions and the size of the root system. [Illustrated with charts.]

THE INFLUENCE OF IODINE ON THE DEVELOPMENT OF THE THYROID GLAND OF TROUT

By

CHRISTOPHER J. HAMRE

The studies reported in this paper have confirmed the results obtained by Marine and Lenhart and by Gaylord and Marsh in that iodine added to the water has been found to prevent thyroid hypertrophy in trout. Thirty and a hundred parts of sodium iodide added per billion parts of water effectively inhibit hypertrophy. Though iodine effectively inhibited physiological thyroid hypertrophy it did not completely inhibit the process of enlargement of the thyroid concerned in its embryonic differentiation. Also it was found that iodine must be administered continuously or intermittently at close intervals to maintain a normal histological condition of the thyroid, for evidences of hypertrophy were found at 30 days after discontinuation of iodine administration, distinct hypertrophy after 82 days and complete disappearance of the normal histological condition by 130 days after treatment.

Iodine was also found to influence growth, thirty parts of sodium iodide per billion parts of water distinctly stimulating growth. In contrast one hundred parts of sodium iodide inhibited growth as long as it was administered, increased rate of growth being found to follow discontinuation of iodine administration, indicating one hundred parts of sodium iodide to be of excessive dosage.

Extreme individual variation in degree of hypertrophy of the thyroids of untreated fish suggest that different individuals may possess thyroids differing in degree of ability to utilize available iodine. [Illustrated with charts and slides.]

KAHOOLAWE, THE ISLAND OF DUST

By

E. H. BRYAN, JR.

Kahoolawe, with an area of 28,000 acres, lies between Maui, Lanai and Hawaii. It is wedge-shaped, 11 miles long and 3½ to 6½ miles wide. It rises to a height of 1,477 feet near the east end. The island is of volcanic origin, and there are six distinct cones, three of which have pronounced craters. On the east and south the land rises abruptly from the sea in cliffs. On the north and west the slope is more gentle, with small bays, having sandy and rocky beaches, and numerous gulches. Much of the central portion is a flat, windswept plain of red hardpan, nearly bare of vegetation, the soil which once covered it having been literally blown away. The rainfall is very scanty and usually comes in a few heavy storms.

The island was used as a place of banishment in the early 19th century. On January 1, 1863, a 50-year lease was given to Elisha H. Allen, which

was assigned in turn to five other lessors, ending with Eben P. Low. On August 25, 1910, the island was proclaimed a forest reserve, in order that the great numbers of sheep and goats might be removed or destroyed, and reclamation commenced. But funds for this work were not available, and after several unsuccessful attempts to rid the island of destructive animals, it was withdrawn from the Forest Reserve, April 20, 1918. Reverting to the public lands, it was leased to Angus McPhee and Harry A. Baldwin, of Maui, by whom it is at present being used as a cattle ranch.

What the vegetation might once have been is hard to determine. There are statements that the island was once forested. At present the only native plants are a few wiliwili trees, pili grass, and scattered remnants of four species of shrubs and herbs. The rest consists of introduced algaroba trees, and immigrant shrubs and weeds, a total of about thirty species. About sixty species of insects have been collected on the island, and eight species of birds noted, none native. There are numerous rats and mice, a few sheep and goats remain; a hundred or more head of cattle and horses are pastured; turkeys, dogs and cats are kept by the population of five adults and four children. Water is stored in tanks and cisterns, there being neither wells nor streams. Special scientific interest lies in the problem of reforestation, and in the interrelationship of the insects, plants, introduced animals, and their environment. [Illustrated with maps and projected photographs.]

BIOLOGICAL RECORDS BY MEANS OF THE MOTION PICTURE CAMERA

By

RAY J. BAKER

The showing consisted of several reels of film, taken with the interval camera, showing the life of a number of flowers, such as *Hibiscus, Sonchus, Crinum* and *Cereus,* as well as the germination of the seeds of the Mung bean. In addition to these, there were several micro subjects, the highly magnified photographs showing the dehiscence of the anthers of *Hibiscus,* the streaming of the protoplasm in the leaves of *Elodea,* and the swimming movements of *Paramoecium* and several other protozoa, together with action studies of a rotifer and the arthropod *Daphnia.*

THE SUGAR CANE PLANT: ROOT PRESSURE AND ROOT PRESSURE LIQUIDS

By

D. M. WELLER

When stalks of the sugar cane plant were cut off just above the surface of the soil and the ends of the stumps connected by means of rubber tubing to flasks, liquids pumped up by root pressure were collected under toluene

for chemical analyses. In 12 hours after attachments were made, as much as 500 ml. to 1000 ml. of liquid were pumped up by the roots of single stools of cane. A greater amount of liquid was pumped up at night than during the day from the same stool. A definite technique of making these attachments was developed. The general purpose of this work was:

1. To compare the amounts and forms of plant nutrients in these root pressure liquids with those in different nutrient solutions in which such plants were grown.

2. To determine whether or not such comparisons would prove useful in determining nutritional requirements of the cane plant and the possible deficiencies of plant nutrients for cane grown under field conditions.

Mercury columns (manometers) were attached to stools of the following varieties of cane: H-109, Lahaina, Yellow Caledonia, D-1135, Uba, and P.O.J. 36. The height of these mercury columns was read every three hours throughout the day and night for a period of twenty-one days. In some instances columns of mercury 140 cm. high resulted. This height of mercury corresponds to that of water columns of more than 60 feet. These data when presented in graphic form showed a rising curve for the night readings and a descending curve for the day readings. These day and night pressure differences correlated with the different amounts of liquid obtained during the night as compared with the amounts obtained during the day.

After irrigations the direction of these curves was upward and, if irrigations were excessive, the direction of the curves was temporarily upward followed by a downward trend. If irrigations were withheld long enough these curves descended to and crossed the zero point and registered as much as 50 cm. of negative pressure. A correlation existed between the pressure curves of certain varieties and their relative drought resistances.

When a tube was attached to the stump of but a single cut stalk of a stool and all of the other stalks of the stool left growing, the stalks of the stool left uncut drew into the plant by "leaf pull" various concentrations of salts added to the tube. The idea of using this technique as a means of studying the effects of various forms and amounts of liquids and gases, salts, disinfectants, stimulants, etc., when thus introduced "hypodermically" into stools of growing cane was suggested. [Illustrated with charts and demonstration material.]

PTERIDOPHYTA OF SOUTHEAST POLYNESIA

By

E. D. W. and F. B. H. Brown

In a survey of the Pteridophyta of southeast Polynesia, including the Marquesas, the Tuamotus, Mangareva, Pitcairn, Henderson, Oeno, Rapa, and Austral Islands, the following interesting data were obtained: of the

122 species and varieties described and the majority figured, 59 (48 per cent) are new species (25) or varieties (34); 64 are endemic to this region and 58 non-endemic. Like the spermatophytes, the pteridophytes may be grouped into floral regions characterized as follows:

I. Marquesas.—High endemism (49%); a primary affinity with the Society Islands and a secondary one with Hawaii. In this latter connection, the first record of *Diellia* occurring outside of Hawaii is found in the Marquesas, while *Selaginella arbuscula,* heretofore considered by some authors to be endemic to Hawaii, is one of the most striking elements of the Marquesan flora.

II. Society Islands.—The relation of its fern flora to that of the Marquesas is such as to suggest a derivation in large part from a common center of origin.

III. Tuamotus.—Low islands without marked endemism. This archipelago forms a center about which the others are grouped. The affinities suggest that this region is the geographical as well as the genetic center of the Pteridophyta of southeast Polynesia.

IV. Austral.—Relatively slight endemism (19%) and scarcely distinct from the Society Islands.

V. Rapa.—Ranks next to the Marquesas and comparable with Pitcairn in high endemism (31%). The primary affinities are with the Society Islands, while the secondary affinities are with the Austral Islands, Marquesas, and Hawaii.

VI. Mangareva, Henderson, and Oeno, marked by low endemism, Pitcairn by relatively high endemism. The chief affinities are with the Society Islands and the Marquesas.

CHARACTERISTIC PROPERTIES OF THE VIRUS OF FOWL-POX (EPITHELIOMA CONTAGIOSUM)

By

O. N. Allen

Epithelioma contagiosum is recognized as a specific infectious disease of fowls. The disease is easily diagnosed by a cutaneous eruption commonly found on the unfeathered parts of the body. These eruptions later increase in size, change in color from whitish yellow-gray to a brown-black, frequently become hemorrhagic and in course of time dry and assume a scabby appearance. Owing to these clinical features of the disease it is commonly spoken of as "fowl-pox."

The disease is caused by a living filterable virus which can be easily demonstrated in any stage of the lesions subsequent to the pus or cutaneous eruptive stage. Virus isolated from spontaneous cases of fowl-pox showed the

following characteristics: 1, the virus is demonstrable in infected tissue and not in normal tissue; 2, the virus is filterable through the pores of a Berkefeld filter; 3, the virus occasionally occurs in the circulating blood stream, but has its strongest affinity for the cytoplasm of cells of the squamous epithelial layer and outer mucous membranes; 4, the virus is infectious in very small amounts; 5, the virus is moderately resistant to drying, high and low temperatures; 6, fowls are immune following recovery from the disease or after a "take" injection of the attenuated virus; 7, there are indications that the virus is host specific; 8, attempts to cultivate the virus have been unsuccessful.

The present investigations have been made possible by the coöperation of Mr. C. M. Bice of the Poultry Division of the University of Hawaii, who is conducting an extensive vaccination program against the disease.

BOTANICAL BONANZAS

By
C. S. JUDD

The rich endemicity of its flora is one of the remarkable botanical features of Hawaii. This is due to isolation and antiquity. Affinities of Hawaiian flora are found not only in Malaya and Australasia, South and Central America, but also in Brazil on the Atlantic side. This flora is considered as a gold mine by visiting botanists. Many of the mines are worked out and certain endemic trees such as the *hau kuahiwi, Cyanea comata,* have been lost to the world. Others such as the *ohai, nanu,* and *kou* are in great danger of becoming extinct.

On the other hand, trees thought to have been rare are being found in large numbers by exploration and there are certain areas where there is a rich assemblage of native trees. These have been advertised by Rock and consist of Kipuka Puaulu, Kapua, and Puuwaawaa on Hawaii, and Auahi on Maui.

An interesting mine of 42 different species of Hawaiian trees was discovered recently in a small gulch in Makua Valley on Oahu. The most notable trees are five *mehamehame,* which was thought to exist only in Kapua. The largest at Makua is 11.3 feet in diameter. Here also is a *kalamona* 38 feet high which Hillebrand described as a shrub 3 to 4 feet high. [Illustrated with slides].

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