PROCEEDINGS
HAWAIIAN ACADEMY OF SCIENCE

SECOND ANNUAL MEETING

MAY 4-7, 1927

BERNICE P. BISHOP MUSEUM

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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 1925-26, three special public meetings of the Academy were held to hear noted speakers, and at the First Annual Meeting, May 19 to 21, 1926, forty papers were presented. The Proceedings of this First Annual Meeting, including abstracts of papers, were published by the Bernice P. Bishop Museum, as Special Publication 11, 1926.

The Second Annual Meeting was held at Gartley Hall, University of Hawaii, May 4 to 7, 1927, ending with a banquet at the University Club.

OFFICERS

1925-1926

President, Frederick C. Newcombe
Vice-President, C. Montague Cooke, Jr.
Secretary-Treasurer, Edward L. Caum
Councilor (2 years), Otto H. Swezey
Councilor (1 year), Frederick G. Krauss

1926-1927

President, Arthur L. Dean
Vice-President, Frederick Muir
Secretary-Treasurer, E. H. Bryan, Jr.
Councilor (2 years), Charles S. Judd
Councilor (1 year), Otto H. Swezey

1927-1928

President, Guy R. Stewart
Vice-President, John F. G. Stokes
Secretary-Treasurer, Paul Kirkpatrick
Councilor (2 years), Nils P. Larsen
Councilor (1 year), Charles S. Judd

PROCEEDINGS OF SECOND ANNUAL MEETING

WEDNESDAY, MAY 4, 7:30 P. M.

Business Meeting

The meeting was called to order by the President, Arthur L. Dean. The first item of business was the election of members. Ballots were distributed, containing the names of persons recommended by the Council, to which the name of W. Ward Nichols was added. The vote resulted in the confirmation of the thirteen names already elected by the Council, and the unanimous election of the twenty-seven new candidates.

The president appointed a committee, consisting of C. Montague Cooke, Jr., Frederick C. Newcombe, and Charles H. Edmondson, to nominate officers for the coming year.

Symposium: Some Natural Resources of Hawaii:

- Soils: by Guy R. Stewart.
- Water: by Max H. Carson.
- Forests: by Charles S. Judd.
- Marine food: by H. L. Kelly (omitted, owing to the absence of the speaker).

THURSDAY, MAY 5, 7:30 P. M.

Symposium: What do we know of the Natural History of Hawaii?

- Botany: Harold L. Lyon.
- Forestry: Charles S. Judd.
- Ornithology: George C. Munro (read by the Secretary).
- Entomology: Otto H. Swezey.
- Marine Zoology: Charles H. Edmondson.
- Anthropology and Ethnology: John F. G. Stokes.

Following the paper by Mr. Judd, which was on "Some Factors Deleterious to the Hawaiian Forest," a discussion was started by the statement of John F. Voorhees that in eastern Tennessee, grassland had been found to be a better water holder than forested areas.

FRIDAY, MAY 6, 7:30 P. M.

Paul Kirkpatrick: Simple earthquake measurements. (Illustrated.)

Nils P. Larsen: The "Oriental Mark," a sacral pigment spot of early infancy.

Charles H. Edmondson: Some factors in the growth of Hawaiian shallow water corals. (Illustrated.)

Frederick C. Newcombe: Comparative growth of the stem and leaf of the sugar-cane.

C. P. Sideris: Similarity between physico-chemical and biological reactions.
John F. Voorhees: Use of the motion picture in teaching meteorology. (Illustrated.)

SATURDAY, MAY 7, 2 P. M.

John F. G. Stokes: The Kauai poi pounder.
C. Montague Cooke, Jr.: A curious habit of an herbivorous snail.
Beatrice H. Krauss: The catalase content of soils and their fertility.
George H. Godfrey: Control of the root knot nematode by trap crops.
Gwendolyn C. Waldron: Certain bacterial reactions.
Louis A. Henke: Pineapple bran: a new feed in Hawaii.

SATURDAY, MAY 7, 1927, UNIVERSITY CLUB, 7 P. M.

Following the Academy dinner, attended by about fifty members and their wives, Arthur L. Dean gave the annual Presidential Address, which was a plea for the teaching of philosophy of an interesting and broadening type.

Reports were read by the Secretary-Treasurer showing an increase in membership, and a substantial balance in the bank. During the year 1926-27, three special public meetings were held. On July 26, 1926, Dr. Lester R. Jones, Professor of Plant Pathology at the University of Wisconsin, spoke on "Disease Resistance in Plants." Two addresses on "Tissue Culture" were delivered, August 18 and 25, 1926, by Dr. Alexander A. Maximow, Professor of Anatomy at the University of Chicago. These meetings were held at Gartley Hall, University of Hawaii, and were well attended.

It was voted that these reports be accepted and placed on file.

The following persons were elected to membership: Arthur R. Keller, Lucy J. Kohler, Doris Mossman Keppeler, Bernice Warner, and Mrs. Paul A. Gantt.

The following votes were passed:

That the Council consider the advisability of holding more than one meeting a year.

That the Academy extend a vote of thanks to the Trustees and Director of the Bernice P. Bishop Museum for having published the Proceedings of the first annual meeting of the Academy.

That the thanks of the Academy be expressed to the University of Hawaii for having provided a meeting place for the annual and special meetings.

That the President, Secretary and Council be thanked for their work.

On recommendation of the Nominating Committee the following officers were elected: President, Guy R. Stewart; Vice-President, John F. G. Stokes; Secretary-Treasurer, Paul Kirkpatrick; Councilor, Nils P. Larsen.

ABSTRACTS OF PAPERS

PRESIDENTIAL ADDRESS

By
ARTHUR L. DEAN

In the December, 1926, number of Harper's Magazine appeared an article by Will Durant on the "Failure of Philosophy." In a recent copy of Science, Professor Davis of Harvard comments on Durant's paper under the title of "The Fortunate Failure of Philosophy." The gentlemen agree that in this modern world philosophy is a failure; Durant with sorrow, Davis with satisfaction.

Accepting a definition of philosophy as the knowledge of human experience seen as a whole or as parts of human knowledge seen in their relation to the whole, I cannot but feel regret that such knowledge is not emphasized in our modern education. As science is the modern and vigorous pursuit of the human mind, is it not the business of those interested in Science to revive philosophy as defined above? Cannot the men of Science bring back into a new system of philosophy the vigorous children of the old philosophy which have left their home and are now inclined to spurn their ancestry? There is need to comprehend the interrelations of the domains of human knowledge and experience. The naive minds encountered among students, theologians, men of business and even students of science emphasize the need of the comprehensive view.

Without attempting the ungracious task of criticizing those in other walks of life, it seems appropriate to at least point out some of the reasons why the man of science needs the discipline of a new philosophy.

1. He is often the victim of his own excellence and as the specialist at the apex of the advancing wedge of knowledge, he is out of touch and sympathy with others and with what they are doing.

2. He fails to realize the relativity of his own knowledge and that it rests on assumptions which he has not and cannot verify. This leads to an unjustified intellectual arrogance.

3. He fails to attempt the answer to the third of the trinity of questions which the proponant of any scientific fact must answer: What is the fact? How do you know it? What of it?

Each scientist needs to ascend the hill top and get that panoramic view of the universe which will allow him to see his own field of work in its true light.

I would that every senior in college might pass through the discipline of a study of philosophy. And what should that philosophy include?

In the first place, I would spend a brief time in facing certain fundamental questions, not to wander in the mazes of epistomology and metaphysics, but to ask the questions and know that men have wrestled with them. What is reality? How do we know or prove the truth of anything? We should know the answers which the advocates of authority have given, the answers of the church and the law, and the answers of men of science, the workers with knowledge based on the evidences of the senses. The student should note the limitations of human knowledge based on the evidences of the senses. The student should note the limitations of human knowledge based on the inabilities of man's intellect to understand certain words which he glibly uses—time, the beginning, nothing, space, energy. The student should face the problems of the human being, the relations of the ego to the material universe, the problems of freedom of choice. Nor can we neglect the questions of religion, in which men seek kinship with an unseen and intangible universe and grope toward a future existence. What is the purpose of the individual and collective human life, and what must be our relations to one another?

As I say, I would not devote too much time to this facing of the unanswered, and in large measure unanswerable problems; but certainly no man can call himself intellectually mature until he has met them and derived therefrom that measure of humility which is the mark of the educated man.

The student would devote the major part of his time to a survey of the great domains of human interest. These would include:

1. Industry. The ways in which men have attempted to satisfy their physical needs and desires.

2. Social relations of men, including political relations.

3. Science, the body of verified and classified knowledge, its method, aim, diversions and accomplishments.

4. The human being, his characteristics and relations.

5. Art, the search for the beautiful and the passion to make and do beautiful things.

6. Religion, the ways in which men have aspired to spiritual knowledge.

I believe that much of our modern university education is incomplete and fragmentary, just because the student rarely pauses to get a view of knowledge as a whole and to see the relation of its parts. Such a sincere attempt would aid in getting rid of littleness and of cocksureness. It might lead toward wisdom, which is the knowledge of the best thing to do.

We are weak, insignificant, short lived; yet humanity is, after all, the most important thing to us. I believe that if we could build up a new interest in a philosophy which is not a fruitless search for impossible definitions, but an ordered review of the whole range of human knowledge and experience, it might point us toward that goal of the great philosophers—the good life lived by the happy man in a perfected social order.

THE SOIL AS A NATURAL RESOURCE OF HAWAII

By
GUY R. STEWART

Hawaii is a country which is peculiarly dependent for its prosperity upon the products of the soil. With the exception of small amounts partly derived from the disintegration of coral rock, all the Hawaiian soils are formed from the weathering and decomposition of a closely related group of basaltic lavas, ash and cinder. Geologically speaking, they are very young; only the first stage of weathering and decomposition of the original lava or cinder has had time to take place. I have found the lava flows on the island of Hawaii constitute a most fascinating laboratory in which to study the change from a primitive rock mass into the beginnings of an elementary soil. In the drier portions of the islands some oxidization and weathering takes place, but there is practically no plant growth. Where rainfall is abundant, mosses and lichens first appear upon the lava. I have found the roots of small mosses which were less than an inch in height penetrating to a depth of six inches or more through minute crevices in the pahoehoe. The mosses are succeeded by larger ferns, sedges and grass. All of these plants leave some organic residues which mix with the small fragments of rock loosened by wind erosion, by root expansion and by the action of water constituting the beginnings of soil in the cracks of the lava. The process of soil formation is very slow; even in the flows of 1840 and 1855 only a few inches of primitive soil material has accumulated in the rock crevices. Many years will elapse before plantations are laid out on the lava flows of the known historic periods.

As the soils of Hawaii have all a similar origin, they have a number of chemical and physical characteristics in common. Contrasted with the average soils of the mainland, they are unusually low in silica—there are very few sandy soils; they contain large quantities of iron and aluminum oxides which have become hydrated by weathering and oxidization. There are no true clays in Hawaii but these oxides give a colloidal clayey texture to many soils and have the same effect upon soil texture that clay would have. They give the soils their loose open porous structure that prevents most soils from packing and forming plow sole. Hence Hawaiian soils, if properly handled, will stand very heavy rainfall without erosion or puddling. Because of the manner of original formation of most of these soils there is an excellent content of organic matter in virgin fields, which helps to preserve a good physical texture and to maintain a normal biological balance.

The present prosperity of Hawaii rests largely upon its crops of sugar and pineapples. These in turn evidently depend upon the maintenance of the present fertility of the soils. Both industries desire to grow the same crop in continuous succession with short intervals for plowing and replanting. Clearly, the first endeavors should be devoted to the prevention of the loss of soil by erosion. If the actual soil mass is reduced, no agricultural measure can avail to maintain fertility. Proper contouring of the land, refraining from planting land that is unduly steep and the prevention of erosion by proper forestation are among the most important considerations.

In the sugar industry it has been possible to grow crops continuously upon land which has been in cultivation steadily for the last fifty years. By careful fertilization this land is now producing the largest crops in its history and there is no present evidence of exhaustion of fertility. At the same time, the lessons of work at Rothamstead teach the value of long time agricultural experiments. I feel that we should have more long time field experiments designed to test the soundness of Hawaiian agricultural practices. Such experiments should be laid out on fields which were first cropped uniformly and the variability of the land determined by statistical methods. [The paper by Mr. Stewart included a sketch of the history of Hawaiian agriculture.]

WATER RESOURCES OF HAWAII

By

MAX H. CARSON

Although in general the rainfall of Hawaii is relatively large, the fresh water available for domestic use, for irrigation, and for power is not abundant. The topography favors torrential run off and the highly pervious lavas permit downward percolation to zones beyond the reach of economical recovery.

The U. S. Geological Survey, cooperating with the Division of Hydrography of the Territory, has been obtaining stream flow records for the past 17 years which are of value in the study of flood waters. No general ground water investigation has as yet been made though certain kinds of ground water have been studied in some sections of the islands.

On all the islands of the group except Molokai, nearly all of the low water flow and much of the medium stage flow of the surface streams have been collected by means of ditches and diverted chiefly for irrigation; on Oahu the artesian supply has been fully developed and it is being overdrawn in the Honolulu area; on Molokai at least a part of the artesian supply has been seriously damaged by overdraft. Large low level springs have been partially developed on Molokai, Maui, and Hawaii; high level water from springs and tunnels has been developed to some extent in sections of Oahu and Hawaii; and extensive ground water development has been made in Maui. Resources still not fully developed are flood flows and ground water, both of which will offer large supplies if methods for their economical utilization can be devised. However, the development of ground water will require a high operation cost and of flood water a high capital cost.

HAWAIIAN FOREST REGIONS AND THEIR CONSERVATION

By

Charles S. Judd

The history of Hawaiian forests may be divided into four periods: (1) the pre-discovery period, (2) the sandalwood period, (3) the cattle period, and (4) the period of water conservation. Hawaii has almost emerged from the third, and is entering upon the fourth of these periods.

The natives divided their land so that each *ahupuaa* should extend from sea to ridge top, and include a section of the native forest, which supplied so many of their wants. The forests during this first period were essentially "supply forests."

The damage done to the forests during the period of sandalwood trade and by the cattle which were allowed to run wild, together with the clearing and cultivation of large tracts of land, have reduced the forests to a point where they are not even adequate to protect our water supply. Efforts are being made, by the formation of forest reserves, the reforestation of denuded areas, and the study of many problems, to save the remnant as a "water-bearing forest."

Certain areas, such as those not needed to protect the watershed, and the lowland algaroba forests, may be classed as "commercial forests."

[This paper is published in full in the Hawaiian Forester and Agriculturist, vol. 24, no. 2, pages 40-47, 1927.]

BOTANY IN HAWAII

By

HAROLD L. LYON

(ABSTRACT BY EDWARD L. CAUM)

Hawaii has received more critical attention, botanically, than any other island group in the Pacific and Hillebrand's Flora of the Hawaiian Islands, although the work on which it was based terminated fifty-six years ago, stands as the most intensive and accurate analysis of any Pacific insular flora. Since Hillebrand's time, other capable botanists have detected many new species, and have added much to the knowledge of the relationships and geographic distribution of the plants within the Territory.

Hillebrand recognized 860 indigenous vascular plants, of which he considered 653 to be endemic. The discovery of additional species brings the number of Hawaiian indigenous species to an even 900, of which 720 should be considered as peculiar to the island flora.

With its 900 species of vascular plants, distributed over 270 genera, the Hawaiian flora exceeds in complexity and richness the floras of most regions of equal area on the continents of the globe.

The land area occupied by the native flora has been much reduced during the past century. Man, with his clearings, fires and stock, has constantly pressed back the native vegetation or swept it away completely, while aggressive introduced plants have quickly taken possession of the land and held it against reclamation by the native species. Many species, never noted and never described, have undoubtedly been exterminated by this process, and it is therefore imperative that a critical study of the Hawaiian flora be made as soon as possible, to preserve for future botanists a correct picture of our indigenous flora.

While a fairly accurate and extensive knowledge of the vascular plants has been recorded, there exists only a meager and scattered literature dealing with the mosses, lichens, liverworts, fungi and algae. Critical field studies of any of these groups would yield much of interest.

The Hawaiian flora shows well the remarkable results arrived at through the geographical isolation of several groups of individuals of the same species. For instance, the indigenous palms of the genus *Pritchardia* are now found in small groups scattered over the mountains of all the islands. The individuals in each group are alike, but those of each group almost invariably differ so markedly from those in every other group that the plants of each group must be recognized as distinct species.

The high endemism displayed by the Hawaiian flora indicates not only that the progenitors of these plants migrated to the islands in the very remote past, but also that there have been practically no additions to the flora from without since that period.

Hawaiian rain forests are extremely sensitive to invasion by stock. The reason for this is that the ancestors of the indigenous plants established themselves on raw lava soils, porous, well drained and well aerated. With the passage of years, this soil disintegrated, silting up the crevices in the rocks, thus checking the downward flow of water and keeping the surface soil perpetually saturated. The plants, finding themselves unable to root deeply in this water-logged soil, spread their roots out very near or even on the surface, where conditions approximated those to which they were accustomed. Here they were overgrown and protected by mosses and small ferns, which, in turn, were protected by the larger ferns and shrubs. But when stock was permitted to roam through the forests, conditions rapidly changed. The tender undergrowth, grazed off and trampled down, left exposed the roots of the large plants, which were in their turn barked and fractured. The trees find these conditions intolerable and soon succumb.

Reluctant as we may be to admit it, we are forced to the conclusion that the Hawaiian flora, as such, is doomed. It cannot long contend with the multitudinous adverse factors now arrayed against it.

FACTORS DELETERIOUS TO THE HAWAIIAN FOREST

By

Charles S. Judd

The native Hawaiian forest is extremely delicate. It is made up of an association of trees, bushes, tender herbs, vines, ferns and mosses, living together in symbiotic relationship, each helping to protect the others. To duplicate such a forest artificially would be a well nigh impossible task, because of the peculiar inter-relationship, and elusive manner in which many of the plants reproduce themselves.

This association of plants required thousands of years to develop to its present state of balance against many odds, during which time it has not had to accustom itself to the attack of either man or beast. As it is, the tender forests were wholly unprepared for the attack of the white man and his animals. Trails, wood cutting, forest clearing and cattle have all helped to destroy the forests. First the tender undergrowth is destroyed, robbing the larger growth of its natural protection, and at last the forest tree succumbs.

Healthy native forest trees are singularly free from the attack of insects in Hawaii. But when the balance between insects and trees is upset, as when the birds are frightened away or certain fungus destroyed, the insects become detrimental to the weakened vegetation. The destruction of the protective zone on the edge of a forest by cattle or cultivation allows its invasion by introduced grass and other aggressive vegetation, such as Hilo grass and staghorn fern, against which the native forest cannot hold its own. Many thousands of acres have been thus destroyed.

The Hawaiian forest heritage is merely a fragment of what was once a magnificent, virgin forest, limited at one time only by such natural conditions as lack of rainfall, elevation, or lava flows. During the last twenty years certain 916,977 acres of this fragment have been set aside for protection. These areas will be increased to at least a million acres—the minimum safe.

Pioneer forestry work has been done, and now the ecological problems should be studied. Research must be conducted to learn more about the subordinate forest vegetation and its relationship to the forest trees. Studies must be made of the staghorn fern and other problems. It is gratifying to report that a little money has been appropriated for such research and that a modest beginning is being made.

[This paper is published in full in The Hawaiian Forester and Agriculturist, vol. 24, no. 2, pages 47-53, 1927.]

HAWAIIAN BIRD LIFE

By
George C. Munro

Important publications on Hawaiian birds include articles by Professor Alfred Newton in Nature (1892); Aves Hawaiiensis by Scott B. Wilson (1890-99); Key to the birds of the Hawaiian group by W. A. Bryan (1901); Avifauna Laysan by Walter Rothschild; Birds of the Hawaiian islands by H. W. Henshaw (1902) and the chapter Vertebrata in Fauna Hawaiiensis by R. C. L. Perkins. The results of the ornithological work of the Tanager and Whippoorwill expeditions (1923-24) have not been published.

Before man reached Hawaii, the forests were tenanted with innumerable small birds; the present list includes 6 families with 57 species. The Polynesian with his fire stick, dogs and pigs, and the European with his goats, cats, rats, cattle, sheep and rabbits upset natural conditions and sounded the death knell of many endemic species which, though structurally specialized to fit the original environment, were unfitted to withstand the changes.

Long residence under island conditions resulted in modification of probably all endemic species; certainly the goose (*Bernicla*), Laysan duck (*Aneus*), and the rails (*Pennula* and *Porzanula*). Extreme illustrations are 18 genera with 41 species of Drepanididae descended from one, perhaps two, forms of honey eating birds; peculiar food conditions and close competition resulted in the development in *Drepanorhamphus* and *Hemignathus* of long curved bills and long tongues for extracting honey from the Lobeliaceae; the development in the *Chloridops* of thick strong bills for cracking the naio nut; the adaption of the bill of *Rhodocanthis* for extracting the green seeds of the koa and the astonishing adaptation of *Heterorhynchus wilsoni* to the habits of woodpeckers and *Pseudonestor* to parrot-like action in obtaining food.

The distribution of the genera and species of Hawaiian Drepanididae is as follows, the iiwi (*Vestiaria*) apapane (*Himatione*), ou (*Psittacirostra*) range over the whole group with a modified form of *apapane* on Laysan, likely now extinct; the ulaaihawane (*Ciridops*), one on Hawaii very rare; the mamo (*Drepanis*), famous feather cloak bird, one on Hawaii very rare; oo-nuku-umu (*Drephanorhamphus*), one on Molokai very rare; *Palmeria,* one inhabiting Molokai and Maui; amakihi (*Chlorodrepanis*), two on Kauai, one on Hawaii and species or varieties on Oahu, Lanai, Molokai and Maui; *Viridonia,* one on Hawaii; *Oreomyza,* two on Hawaii and one each on Kauai, Molokai, Lanai, Maui and Oahu; *Loxops,* one each on Kauai, Maui, Oahu and Hawaii; akialoa (*Hemignathus*), one each on Hawaii, Lanai, Oahu and Kauai; nukupuu (*Heterorhyncus*) one each on Kauai, Oahu, Maui and Hawaii; *Pseudonestor,* one on Maui; *Telespiza,* one on Laysan rare and perhaps another on Nihoa; *Loxioides, Rhodacanthis* and *Chloridops* one of each on Hawaii; *Dysmorodrepanis,* one on Lanai. The peculiarities of Drepanididae are the small number of species compared with the number of genera, the confinement of species to the respective islands, and the number of restricted species on the island of Hawaii.

The honey eaters (Meliphagidae) include but 5 species of two genera, *Chaetoptila* with one extinct species being the latest arrival; oo (*Acrulocercus*) one species each on Hawaii and Molokai (both rare), Oahu, (extinct), and Kauai.

The friendly little "miller bird" of Laysan (*Acrocephalus*) has gone with the moths on which it fed. Of the thrushes (Turdidae) one genus, *Phaeornis,* is found, one species on Hawaii, two on Kauai, and one each on Lanai and Molokai. Of the flycatchers (Muscicapidae) also only one genus, *Chasiempis,* is found—the *elepaio,* three species, one each on Hawaii, Oahu, and Kauai.

The hawk (*Buteo*) and the crow (*Corvus*), complete the list of endemic land birds, both confined to Hawaii, the crow with a very restricted range.

Perkins does not admit that the *amakihi* of Oahu, Maui, Molokai and Lanai are worthy of specific rank, but are varieties of *Chlorodrepanis virens, Gmelin,* of Hawaii, and doubts the validity of the genus *Drephanorhampus* Rothschild, as separate from *Drepanis,* Temm.

The waders, *kolea, akekeke, ulili, hunakai* and *kioea,* and the pintail and shoveller duck are regular visitors, often bringing with them stragglers of both waders and swimming birds. Of the number of different species of gulls among the stragglers no species has yet made its home in Hawaii.

The European sparrow has spread with remarkable slowness, the small amount of grain culture probably account for it.

I believe the much abused mynah bird is more of a friend than an enemy. With the *kolea* and *akekeke,* which should be rigidly protected, it is of inestimable value in destroying caterpillars and wire worms, and in reducing parasites on stock.

ENTOMOLOGY IN HAWAII

By

OTTO H. SWEZEY

The study of the insect fauna of Hawaii was commenced by the Rev. Thomas Blackburn, who resided in Honolulu 1876 to 1882. He may justly be styled the "father of Hawaiian entomology," for his pioneer work revealed the highly interesting endemism of our fauna, aroused the interest of British entomologists, and eventually led to the systematic exploration by R. C. L. Perkins, and the publication of the immense monograph, Fauna Hawaiiensis.

The specimens collected by Perkins from 1892 on, worked up by a number of specialists, and published in Fauna Hawaiiensis, total about 3325 species, of which 82 per cent are considered endemic. Perkins expressed the opinion that about half of the existing species of native insects had been collected. It was his opinion that the islands have always been isolated and that the original ancestors of the native fauna had reached them as chance immigrants, by floating on driftwood, air currents, their own flight, etc. The present species have resulted by evolution during a great length of time.

Since the publication of the Fauna Hawaiiensis, no one has been working exclusively on the native insect fauna, but all the entomologists of the several institutions, working chiefly on economic entomology, have been interested in advancing the knowledge of the native insect fauna. These entomologists have been associated in the Hawaiian Entomological Society since 1905, holding monthly meetings, and have published six volumes of proceedings, amounting to 2460 pages. About 400 new species of native insects have been described therein, and much valuable data on habits and life history have been published.

The Natural History of Hawaii by William Alanson Bryan, published in 1915, devotes 20 pages to the native insects and 30 pages to important economic insects.

About 4000 species of insects are now known from Hawaii, 80 per cent of which are not known elsewhere. The fauna is made up of comparatively few families, and many groups found on all continental areas are entirely absent. Many of the genera are endemic and have a large number of species. These are so closely related as to indicate that they have only recently been evolved, and species-making is still in progress. Many of the species are flightless, so that isolation of species is readily attained, and the fauna of each island is peculiar to itself, a large proportion of species being present on but one island. Many species are very rare. Many are restricted to a single food plant, making their distribution dependent on that of the host. Progress is being made in faunistic study of particular trees.

Although much work has been done, there are still many new species to be discovered, and much to be learned concerning their distribution. More important is the study of their habits. Much has yet to be done on insect ecology. Many problems of importance arise in whatever line of entomological research one may engage. There is need of breeding work in connection with a study of species formation, necessitating a prolonged residence in the mountain forests.

MARINE ANIMAL LIFE OF HAWAII

By

CHARLES H. EDMONDSON

Although certain well known organisms are absent from Hawaiian waters and others are rare, the fauna is characterized by great variety and considerable numbers. Much of it is hidden from the casual observer. For example, a block of coralline algae about 4 by 6 inches in size recently examined included 30 species (138 specimens) of marine animals.

Because of the work of the "Albatross," certain groups of Hawaiian marine fauna below the 100 fathom line are better known than in shallow water. Of near shore forms the stony corals (124 species), the echinoderms (about 200 species), the mollusks (1400-1500 species), the annelids (about 70 species) are fairly well known and recent work has greatly enlarged the knowledge of crustaceans and fishes.

Future work of taxonomic character is especially advisable on sponges, the shallow water hydroids, the marine worms, the bryozoans, certain classes of mollusks, crustaceans and primitive chordates—groups in which very noticeable gaps should be closed up. The true taxonomist is not merely a namer of organisms but is alive to all of the complicated questions of variation and distribution.

Furthermore in almost every group of marine animals in Hawaiian waters, but especially among the coelenterates, the echinoderms, the mollusks, the crustaceans, and fishes, the ecologist may find ample material for his desires. The conditions surrounding animal life in the sea are not simple conditions. Not only the biologist but the chemist, the physicist and the geologist each must add his contribution before it is possible to unravel the complicated problems which so obviously exist among the intimate associations of organisms in the sea.

ANTHROPOLOGY IN HAWAII

By

John F. G. Stokes

The literature of Hawaiian anthropology is made up of accounts by the voyagers (Cook, Kotzebue, Freycinet and others); missionaries and travelers (Ellis, Dibble, Andrews, Campbell, and others); native writers in the vernacular (Malo, Kamakau, and others); and white residents (Rae, Fornander, Alexander, N. B. Emerson, J. S. Emerson, Thrum, Brigham, Emory, Sullivan, and others). Much of this material is to be found in such serial publications as: the Kuokoa, Au Okoa, and Catholic newspapers in Hawaiian; the Sandwich Island Magazine, Hawaiian Spectator, The Polynesian, The Friend, The Hawaiian Annual, and publications of the Hawaiian Historical Society and Bernice P. Bishop Museum publications, in English.

The objective material is housed mostly in Bernice P. Bishop Museum and the British Museum. Archaeological field work is limited to a small number of village sites, to temple and burial sites protected by law, irrigation and fish pond systems. It refers more to structural work than to artifacts or stratifications.

The interpretative studies completed so far are most important in the subject of somatology. Sullivan and Dixon, using different material, have both come to the conclusion that four racial elements are present in the Hawaiian people—Sullivan intimating the possibility of two more. The establishment of the existence of racial admixtures has cleared the horizon for a better understanding of possible cultural stratification. Another worker, Frederick Wood-Jones, has lately commenced a racial study from the morphological rather than the anthropometrical viewpoint. The somatological material still available is considerable.

Topical studies have engrossed most of the writers. The greatest interest has been displayed in tradition and folklore (Fornander, Thrum, Westervelt and others). In mythology and religion, Thrum and Brigham have completed unpublished studies. Handy includes much Hawaiian material in his account of Polynesian religion. Bastian has contributed "Die heilige Sage," and J. S. Emerson has described sorcery. The chants and workings of the hula, and Hawaiian poetry by N. B. Emerson, Hawaiian music by Helen Roberts, and the Hawaiian novel Laieikawai, translated by Miss Beckwith, have been published. Hawaiian Proverbs by H. P. Judd and Hawaiian String Figures with the chants by Lyle Dickey are nearing completion. In philology, dictionaries or grammars have been prepared by Andrews (also Andrews-Parker), Hitchcock and Alexander. Of legal subjects land tenures have been treated by Dole and fishing rights by Massee. In material culture, much work has been done by the staff of Bernice P. Bishop Museum.

It is probable that more than two-thirds of the possible data regarding Hawaiian culture and available today have been recorded; but there is need for more topical studies, particularly in correlating the data in literature with the objective and archaeological material. Among these should be mentioned medicine, sports and games, war, fishing, canoes, ancient navigation, agriculture, irrigation systems, engineering and structural work, art, law and chiefly tapu. Enough material is on hand for an enquiry into the psychology of the primitive Hawaiian. In all these topics it is desirable to include comparative data, particularly from other parts of Polynesia, for the purpose of recognizing any cultural stratification which may be indicated by the different racial elements recognized by the somatologists.

At the present time conclusions regarding the localization of the racial or cultural affinities of the Hawaiians are dependent more upon general Polynesian than strictly local data. Hawaii links up closely but in varying degree with the rest of Polynesia, from which it is inseparable. However, there are proportional differences in the racial elements as well as cultural differences which will necessitate further study before it can be ascertained whether they are due to long isolation or to different racial influences.

SIMPLE EARTHQUAKE MEASUREMENTS

By
PAUL KIRKPATRICK

The mechanical problem of the overthrow of a supported, inclined column by horizontal simple harmonic motion has been solved, and the solution rigorously tested by laboratory experiments. The result obtained is concisely stated by the formula $a = g\theta\sqrt{1+\frac{4\pi^2R^2}{g\,L\,T^2}}$ where a is the maximum acceleration of the motion, g is the usual gravitational acceleration, θ the angle of inclination of the column from the vertical, R and L the radius of gyration and the effective length of the column, and T is the period of the oscillation. The movement is in the plane of the angle θ. The maximum acceleration defined as above is the maximum acceleration necessary and sufficient to bring about the overthrow of the column.

This result furnishes a simple method of measuring the horizontal intensity of earthquakes, since intensity is customarily measured by maximum acceleration. A series of similar columns of known dimensions may be mounted at various angles of inclination, such that the quake upsets some and leaves others standing. If the second term under the radical sign be made small, a condition which may be realized, the maximum acceleration becomes known with a precision depending upon the closeness of the spacing of the angles of inclination. Instruments of this kind have been constructed.

[An extended summary of this paper was published in Science, vol. 65, pages 379-380, 1927. A more complete paper appeared in the Bulletin of the Seismological Society of America, June, 1927.]

THE "ORIENTAL MARK"

By
NILS P. LARSEN AND LOIS S. GODFREY

The "oriental mark" is a skin spot of irregular size and shape occurring in the newborn child, usually in the sacral region. The authors tabulated the records of its presence or absence on 693 children in Hawaii. The data in 296 cases of interracial crossings were especially interesting, suggesting a Mendelian inheritance. The tabulated results interpretated in the light of a genetic theory which the authors propose, uphold the conclusion reached by other investigators that the factors for the "oriental mark" occur in all races, but in different degrees.

[This paper has been published in the American Journal of Physical Anthropology, vol. 10, no. 2, pages 253-274, 1927.]

SOME FACTORS IN THE GROWTH OF HAWAIIAN SHALLOW WATER CORALS

By
CHARLES H. EDMONDSON

The common Hawaiian corals grow slowly. The living cells must take the salts from the sea water and deposit them as limestone. This process takes time. The most rapidly growing coral on Hawaiian reefs is probably *Pocillopora meandrina,* some colonies of which will grow in a vertical direction more than 40 millimeters a year. Many other species grow not more than 6 or 8 millimeters annually. Corals grow faster on the windward side of Oahu than on the leeward side, and seem to grow faster during the winter months than during the summer.

The growth of corals depends upon many different conditions in their environment: Temperature and salinity of the water, silt, light, and food supply. To make good growth these and other factors must be favorable. Species of coral vary greatly in their responses to physical and chemical conditions. (Examples cited.) Among the most destructive agents of shallow water corals are seaweeds.

Coral colonies are made use of by other organisms as places of concealment. In one coral colony were found more than 50 other marine animals including 17 different species, some may actually feed upon the coral polyps.

[This paper will be published in full by Bernice P. Bishop Museum.]

COMPARATIVE GROWTH OF STEM AND LEAF OF THE SUGAR-CANE

By
FREDERICK C. NEWCOMBE

This abstract pertains only to the variety of cane known as H 109, though other varieties show the same general relations. Details as to methods of measuring are omitted for the sake of brevity. Also only the elongation of the parts is here considered.

A definite starting point for measuring may be chosen as the leaf-joint, the highest exposed leaf-joint as seen at the lower limit of the spindle. The sugar-cane leaf, like most grass leaves, has three parts: the blade, the sheath, and the joint connecting the blade and sheath.

If leaf blades are measured, those which show above the highest visible leaf-joint have an average length of about 125 cm. The blades of two to four leaves still younger, have the same length as those just mentioned, showing that the blades are fully elongated while the lower 10 to 15 cm. are concealed from view.

The leaf-sheath averages about 30 cm. long when mature. In the leaf with the highest visible joint the sheath is fully elongated; and the sheaths of two or three younger leaves are also fully elongated, although these sheaths are wholly concealed from view within the sheaths of the older leaves.

The amount of sheath that a leaf shows above the joint of the next older leaf is in most plants wholly due to the elongation of the stem of the plant. A variation from this usual behavior may be due to a change in temperature or in nutrition. From the relations given above, it follows that the length of the sheath exposed above the joint of the next older leaf is about the length of the stem internode (joint) below the insertion of the sheath of the first mentioned of the two leaves.

Thus it can be found, by measuring and dissecting, that the blade of a leaf is fully elongated when the sheath is only about one-third grown, and the stem below has hardly begun to elongate; and that the internode of the stem from which a sheath grows is only one-fifth grown when the sheath is fully elongated.

SIMILARITY BETWEEN PHYSICO-CHEMICAL AND BIOLOGICAL REACTIONS

By

CHRISTOS P. SIDERIS

An attempt is made to compare biological with physico-chemical reactions, and interpret the former in terms of the latter. To just what an extent this is feasible remains to be proven by further experimentation.

Protein A of the pineapple stem has been found to be isoelectric at pH 6.43. Solutions of this protein were treated with different volumes of 0.1 normal HNO_3 and NaOH and thus brought to different pH values ranging from 2.0 to 11.0.

Three sets of such solutions were prepared. Set (1) was inoculated with a pure culture of *Fusarium martii,* (2) *Verticillium sp.* and (3) *Penicillium sp.* Both mycelium and spores were used for the inoculation of the different cultures. The growth of the organisms at room temperature (about 27° C.) was compared with cultures of the same organisms grown on solid and liquid nutrient media.

Fusarium martii developed best in the solutions ranging between pH 6.5 and 9.9. *Verticillium* in those between pH 6.4 and 3.0; and *Penicillium* in all except at pH 6.4—the isoelectric point of the protein. Thus, none of the organisms grows in isoelectric pineapple stem protein-A. *Fusarium* will grow in solutions having pH values above the isoelectric point of the protein;

Verticillium in solutions of the protein having a pH value below the isoelectric point; and *Penicillium* in solutions with pH values either above or below the isoelectric point.

An explanation is suggested by assuming that the protein is made available for the use of the fungus by enzymes released by these organisms; that these enzymes are of protein composition; and that their chemical reactivity may be attributed to either of their two chemical radicals, NH_2 or COOH. It may further be assumed that the enzyme of *Fusarium* carries a positive charge and that of *Verticillium* a negative charge. The conditions which prevail with the enzyme of *Penicillium* are difficult to explain. There may be two enzymes, one carrying a positive charge and operating above the isoelectric point, and the other a negative charge and operating below the isoelectric point of the protein.

THE USE OF MOVING PICTURES IN METEOROLOGY

By
JOHN F. VOORHEES

There are at least three methods by which moving pictures may be used in teaching meteorology, and two of these promise much as aids in the study of that science.

The first and simplest method is illustrated by a moving cartoon showing from one side a cross section of a thunderstorm (after Humphrys) with moving arrows to represent the air currents within the storm and falling dots to represent the rain. This and similar pictures would perhaps have their greatest value in giving the beginner a clear idea of what is going on in the air under various meteological conditions. This method could also be used to good advantage in explaining and illustrating theories of meteorological movements.

The second method, not illustrated at this time, is to show the advance of high and low pressure areas, or warm and cold areas, by means of moving isobars or isotherms. If the data were taken from barograph and thermograph traces, making a map for each hour of the day, much detailed information of the movement of pressure and temperature conditions might be brought to light. The advance of the freezing line in the fall and its retreat in the spring, and many other meteorological phenomena could easily be illustrated in this way.

The third method, which should be valuable for both the beginner in meteorology and the student of cloud formation and wind movement, is to take pictures of actual clouds. The pictures shown were taken at intervals of five seconds and when run at the usual speed, multiplied the velocity of the clouds by eighty. The picture of the clouds coming over the Koolau mountains resembles more than anything else, boiling, shooting flames, except that the color is wrong. For the purpose of the study of wind currents and cloud formation, an exposure every two seconds or every three seconds would likely be best. Pictures of this kind, of thunderstorms, tornadoes, waterspouts, hailstorms, and many other phenomena would be both interesting and valuable, not only in the class room and laboratory, but also before the public.

THE FOOD-RUBBING STONES OF KAUAI, IN CONNECTION WITH CULTURAL DIFFERENCES IN HAWAII

By

JOHN F. G. STOKES

As compared with the island of Hawaii, the native culture of Kauai and Niihau presents differences in customs, artifacts and dialect. For instance, on Hawaii the vegetable staple poi was prepared by the men, except on extraordinary occasions; on Kauai, men or women did the work. Apparently, it was formerly woman's work only, and the preparation of poi by the men represented Hawaii influence.

On Kauai, the men and women used different implements in the work. The women rubbed or ground the paste with a particular type of implement, perforated in stirrup form; the men pounded it, using the conical Hawaiian form of pounder. The perforated stirrup form was evolved locally through many fine gradations, from imperforated stirrup types which in turn refer to a prototypic form, quadrangular in outline and in sections—an angularity unusual for Hawaii.

A group of seven stone grinders recovered from Kauai are of generalized type though differing in form. None of them are adaptable to a hand grip; some seem to have been adapted for lashing on a wooden hand piece. There is enough to suggest, however, that the prototype of the imperforate stirrup forms was associated with or derived from some such a grinder, as does the distribution at present known.

None of these implements is localized elsewhere in Hawaii or in Polynesia. The technic of the prototypic form and of the grinders finds its nearest analogy in implements on the deserted islands of Nihoa and Necker. In structural work, it is present, though rare, in Hawaii, although better represented in southern Polynesia. So far as known, the grinders are without analogy elsewhere. The stirrup forms are represented in Alaska and British Columbia (where the analogies are not close), in Mexico and in Costa Rica (where perforated and imperforate forms resemble the Kauai rubbers). The coincidence is at least a startling example of parallel development.

Drifts to the Hawaiian islands of human beings and objects recorded through history, tradition and observation have indicated an origin from Japan on the one side and North America on the other. There are many Hawaiian customs and artifacts not represented among the southern Polynesians, some of which find analogies in northeast Asia or northwest America.

No conclusions are possible with the data in hand, but further light may be obtained when outside analogies with the grinder may be found.

A CURIOUS HABIT OF AN HERBIVOROUS LAND SNAIL

By

C. MONTAGUE COOKE, JR.

An herbivorous snail, *Partula zebrina,* found in Tutuila, Samoa, has acquired the habit of swallowing other species of snails. From the relative size of the victims this must be accomplished with much inconvenience, if not pain, as not only the alimentary organs, but even the central nervous system are stretched to many times their normal size. As the secretions in the stomach apparently attack only the calcareous material, leaving the animal matter practically untouched, at least until some time after the shell is completely dissolved, it is presumed that these shells are swallowed solely to procure lime. This can be explained also by the relatively larger proportion of young specimens showing this habit than adults, as the growing shell needs a larger amount of lime.

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

THE CATALASE CONTENT OF SOILS AND THEIR FERTILITY

By

BEATRICE H. KRAUSS

Enzymes are catalytic agents which both plants and animals use for the decomposition or synthesis of organic matter. The reactions accelerated by enzymes may be classed as (1) hydrolytic, (2) oxidizing and reducing, and (3) clotting or coagulating. The catalases are a group of oxidizing enzymes which accelerate the decomposition of hydrogen peroxide, evolving gaseous oxygen.

Soils rich in humus and bacterial and fungal flora are held to be fertile soils. The fertility is the result of the good physical condition that humus adds to the soil and the biochemical reactions during which various salts essential to plant life are released and nitrogenous substances are synthezied from atmospheric nitrogen. Catalase, being a constituent of living tissue, should be found in greater abundance in soil rich in humus and bacterial and fungal population than in soil containing little or none of these constituents. The catalase content of soil is thus a measure of the humus and biological activity of that soil, and hence of its fertility. Certain investigations in Europe and America have demonstrated the possibility of this assumption.

At the Association of Hawaiian Pineapple Canners' Experiment Station, a dozen soil samples were tested for their catalase content, by adding to 5 grams of the soil sample 40 cc. of distilled water and then 10 cc. of hydrogen peroxide. This mixture was shaken and allowed to react for fifteen minutes in an Erlenmeyer flask connected to an Elliot gas analysis apparatus. The volume of oxygen released from the peroxide through the action of the catalase, was an indication of the catalase content of the soil, and likewise showed the relative fertility of the soil. The results thus obtained correlated closely with the observed type and condition of the soil, and with the growth of pineapples and other plants.

CONTROL OF THE ROOT KNOT NEMATODE BY TRAP CROPS

By

GEORGE H. GODFREY AND HELENE MORITA

The trap crop method has long been mentioned in the European literature as one means by which the root-knot nematode may be combated. Experimental work was conducted at the Pineapple Experiment Station, Honolulu, using heavily infested soils in enclosed containers and tomato plants grown in small paper pots of sterile soil as trap crop. In twenty-seven days nematodes which infested the tomato roots at the time they were transplanted or shortly after, had reached maturity and egg masses were evident. At any time prior to the twenty-seventh day plant roots removed from the soil carried with them the nematodes in immature condition. By this means a first planting removed 98 per cent of the nematodes, and second and third plantings reduced the population to practically zero. The roots removed were used to inoculate pots of sterilized (nematode-free) soil. Roots twenty-seven days old carried with them infective material in the form of newly developed eggs. Roots less than twenty-seven days old, many of them showing thousands of galls, carried over only slight infection showing that the vast majority of the nematodes contained within the galls were immature and immobile, and incapable of infesting a subsequent crop. This indicates the possibility of planting a fast-growing nematode susceptible crop and plowing it under at the proper stage with resulting heavy reduction in the nematode population of the soil.

[This paper appears in the Proceedings of the Pineapple Men's Conference, March 23-26, 1927, published by the Association of Hawaiian Pineapple Canners.]

THE PINK DISEASE OF PINEAPPLE FRUITS

By
Gwendolyn C. Waldron

A bacterial disease of pineapple fruit, called the Pink Disease because of the bright pink color produced in the flesh of the fruit in advanced stages of infection, is of general occurrance in Hawaii, but has received no extended study. The disease is seasonal, occurring from December to April, mainly in scattered replants, which fruit out of season. No prevention or cure has so far been found.

The pink coloring is generally limited to the base of the ripening fruit, which would indicate that the point of infection is near the base, or that the bacteria develop better there, due to the greater concentration of sugar. When the infection has advanced so far as to give the pink color, the tissue becomes soft, spongy and quite watery. There seems to be no external evidence of infection, the shell remaining firm and normal in appearance.

The organism causing the disease was readily isolated from affected pineapples, on Dextrose beef-agar, glistening cream-white colonies appearing in 24 hours. It is a very small, thin rod, 1.25 microns long by 0.63 microns wide. It readily takes a gram negative stain, and is non-sporulating and only sluggishly motile.

The most annoying feature of the disease is that infected fruits turn brown when cooked. As there is no way of picking out such fruit by appearance or odor before it is processed, except in advanced stages, a study was made to find some substance which would give an instantaneous reaction. After much experimenting, it was found that ammonium phosphate (secondary) brought about the desired result. An indicator paper could be made by treating absorbant paper with a solution of this compound and drying it. A few drops of juice from pineapples infected with this disease will cause the indicator to turn dark brown, when subjected to a jet of steam. This indicator has proved specific for this type of infection, other pineapple discolorations or infections not producing the reaction.

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PINEAPPLE BRAN, A NEW FEED IN HAWAII

By

Louis A. Henke

Pineapple bran is the outer shell of the pineapple, which has been dried and ground to varying degrees of fineness, depending on the class of animals for which it is prepared.

The feed has been made commercially in Hawaii since 1923. Production in 1926 amounted to 6966 tons of the dried material. Much of this is exported to the mainland. Approximately three per cent of the weight of the fresh fruit represents the possible out-put of pineapple bran from any cannery.

This dried feed contains 3.62 per cent protein, 1.01 per cent ether extract, 72.34 per cent carbohydrates, of which 18.23 per cent is fiber and 3.70 per cent ash. It contains five times as much vitamin A as grains, and vitamin B is present in about the same amount as in whole wheat. The calcium content is higher than that of wheat, corn, oats, or barley, but the phosphorus content is lower than in these grains.

Repeated experiments at the University of Hawaii and elsewhere show that, when properly supplemented with protein feeds, it is a good and economical feed for horses, mules, and fattening hogs. The material has also been fed extensively to dairy cows and, when properly supplemented, seems to have given satisfactory results. Pineapple bran, finely ground, has also been fed to poultry, but experimental evidence to date on its value for this purpose is inconclusive.

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