

PROCEEDINGS
HAWAIIAN ACADEMY
OF SCIENCE

THIRD ANNUAL MEETING

MAY 16-19, 1928

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HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, with "the promotion of research and the diffusion of knowledge" as its stated objects.

The activities of the Academy have comprised public addresses, and annual meetings for the presentation of original papers and reports. The Proceedings is the only publication sponsored directly by the Academy, the present issue being the third of this series.

Any resident of the Territory of Hawaii interested in science is eligible for election as a member of the Academy, and non-residents who are interested in scientific problems relating to Hawaii may make application for election as corresponding members. Nomination to membership in either class must be indorsed by three members of the Academy.

Communications to the Academy may be addressed (1928-29) to the President, Nils P. Larsen, Queen's Hospital, Honolulu, or to the Secretary-Treasurer, Paul Kirkpatrick, University of Hawaii, Honolulu.

PROCEEDINGS OF THE THIRD ANNUAL MEETING

WEDNESDAY, MAY 16, 7:30 P.M.

GARTLEY HALL, UNIVERSITY OF HAWAII

Preliminary announcements.

Election of members.

Presentation of papers:

Paul Kirkpatrick and Margaret Dewar: Polarization of reflected X-rays.

Victor Pietschmann: The X-ray in biological work.

George F. Straub: Electrical injuries.

Nils P. Larsen: The poison spider.

E. D. W. Brown: Dietary types, their geographical distribution.

Carey D. Miller, Doris Hair, and Marjorie Abel; Food values of some oriental foods.

THURSDAY, MAY 17, 7:30 P.M.

GARTLEY HALL

Frederick Wood Jones: The morphological approach to physical anthropology.

J. C. Thompson: Primitive mentality.

Andrew W. Lind: A factor in juvenile delinquency.

Romanzo Adams: Factors affecting the rate of intermarriage among people of the racial and cultural groups of Hawaii.

E. H. Bryan, Jr.: Educational recreation in Hawaii.

Peter H. Buck (Te Rangi Hiroa): The significance of Samoan ceremonial.

FRIDAY, MAY 18, 7:30 P.M.

GARTLEY HALL

H. L. Lyon: Palms in tropical forests.

Charles S. Judd: The propagation of indigenous tree seed.

W. P. Alexander: The influence of nitrogen fertilization on the sucrose content of sugar-cane.

A. J. Manglesdorf: Self-sterility in sugar-cane.

F. B. H. Brown: The pre-Linnaean botany of the Polynesians.

J. F. Voorhees: A quantitative study of the rainfall of Oahu.

SATURDAY, MAY 19, 2:00 P.M.

GARTLEY HALL

- C. H. Edmondson: The relation of *Atya bisulcata* to *Ortmannia henshawi*.
C. Montague Cooke, Jr.: Evolution as a probable index of the relative ages of the Pacific islands.
F. B. H. Brown: Was the Tuamotuan Archipelago ever mountainous??
Kenneth P. Emory: Archaeology of Nihoa and Necker.
H. R. Hopf: Influence of environment upon the office worker.
Iwao Miyake: Acoustic absorption coefficients of a vesicular wall plaster.

SATURDAY, MAY 19, 6:30 P.M.

UNIVERSITY CLUB

The annual dinner was attended by 45 persons. It was followed by the presidential address, the reports of officers and committees, and the election of the following officers for the year 1928-1929:

President, Nils P. Larsen
Vice-President, Harold S. Palmer
Secretary-Treasurer, Paul Kirkpatrick
Councilor, E. H. Bryan, Jr.

ABSTRACTS OF PAPERS

SOME OUTSTANDING DEVELOPMENTS IN AGRICULTURAL SCIENCE DURING 1927

Presidential Address

By

GUY R. STEWART

The divisions of the subject chosen for discussion may appear at first glance to be comparatively unrelated. They have, however, this in common. Each exemplifies some application of the methods of pure science to the problems of agriculture. The theme might possibly be stated as the recent applications of science to agriculture, with exemplifications from four different fields.

There have been several developments in the field of agricultural science during the past year which are of more than passing interest. First among these might be placed the investigations of E. C. Baly and his co-workers at the University of Liverpool upon photosynthesis. The work of Baly and his associates has shown that when carbon dioxide and water were exposed to ultra-violet light by themselves in quartz tubes, only traces of any reaction product were formed. When, however, powders of large surface area were present, such as aluminum powder, barium sulphate, aluminum hydroxide, or the basic carbonates of alumina, zinc, or magnesium, the reaction proceeded to the formation of measurable traces of complex sugars. This not only helps to explain the mechanism of photosynthesis, but it may foreshadow the synthetic production of sugars and starches.

There has been a remarkable development in another closely related field of agricultural science, that of plant nutrition. Early work in plant physiology just as in human physiology indicated that a comparatively small number of elements were absolutely essential for plant growth. Lately a whole series of discoveries has been published which tends to show that minute amounts of manganese, bromine, iodine, zinc, alumina, copper, and flourine are one or all necessary for many of our cultivated plants.

Probably the most definite advance in the broader aspects of soil fertility occurred this past year through the meeting of the International Society of Soil Science in Washington, D. C. A notable group of investigators attended the conference and presented papers dealing with all phases of the study of the soil.

There has been a series of investigations carried out independently in several places which possesses more than passing interest for any student

of science. This work has consisted of causing mutations or actual variations in the usual genetic inheritance by exposing plants or insects to X-rays. The experiments in tobacco plants were made by Goodspeed and Olson in California. In Texas, Muller obtained the same increase in the number of mutations by exposing fruit flies to X-rays. This work promises to help explain one possible cause of the mutations which so interest students of heredity.

Agriculture has been only one of the various fields of human activity in which the past year has seen an increasing use of and reliance upon the methods of science. The present discussion has treated largely of the applications of science.

In closing it might be pointed out that even modern industry, under the National Research Council, is contributing to the development of pure science, without direct expectation of benefit, beyond the indirect return which comes to the whole nation as the eventual result of the advancement of human knowledge.

THE X-RAY IN BIOLOGICAL WORK

By

VICTOR PIETSCHMANN

(Abstract by the Secretary)

Lantern slides are projected which illustrate the advantage of radiographs in biological studies, particularly of fishes. It is considered that this valuable aid to such research has been unduly neglected. Such studies leave the organism intact and portray all parts in their correct positions—advantages which dissection can not claim.

Injections of radiographically opaque fluids, such as barium sulphate, reveal all cavities, even the finest capillary vessels, with the utmost clarity; while at the same time, the labor and time involved in such a preparation are negligible as compared with investigations by other methods.

It is considered that the methods herein advanced are capable of profitable application to the fields of paleontology, botany, and entomology.

POLARIZATION OF REFLECTED X-RAYS

By

PAUL KIRKPATRICK AND MARGARET DEWAR

Work is in progress for the purpose of determining (1) the state of polarization of the K characteristic radiation of tungsten, and (2) the

magnitude of the polarization imposed upon a beam of X-rays by the process of crystal reflection.

Results to date on (1) are consistent with the supposition that this radiation is unpolarized, as has usually but not always been assumed in the past. The second question is being investigated by scattering at right angles a beam of X-rays which has been reflected by a crystal of rock salt. Investigation of the distribution of scattered intensity permits a deduction of the polarization of the reflected radiation. Primary polarization of the incident radiation is eliminated from these measurements by inclining the X-ray tube at an angle of 45 degrees to the plane of reflection.

Measurements at two angles of reflection have been completed. For $2\theta=20^{\circ} 10'$ a polarization ratio of .875 is obtained. For $2\theta=15^{\circ} 08'$ observations yield the value of .932. The values deduced from the classical theory of electromagnetic radiation are respectively .881 and .932. The agreement thus obtained between experiment and theoretical prediction lends support to the view that the process of crystal reflection is a purely classical phenomenon, not requiring the use of the assumptions of the quantum theory.

SELF STERILITY IN SUGAR-CANE

By

A. J. MANGELSDORF

A large number of self-pollinations involving many sugar-cane varieties and seedlings have shown self-sterility to be the rule in Hawaii. Complete self-fertility was found to be rather a rare exception.

This is true even for varieties having normal, viable pollen and ovules, as evidenced by their performance when used in crosses with other canes. Badila, for example, produces an abundance of good pollen which functions normally in crosses. Its ovules also are highly fertile when pollinated with various pollen-producing varieties. When self-pollinated, however, very few seedlings result, in spite of the fact that the stigmas are well covered with their own pollen.

The situation is analogous to that in many other species of self-sterile plants, of which sweet cherries, clover, and rye are familiar examples. The cause in certain species has been found by investigators to be due to the slow growth of the pollen tubes down their own styles as contrasted with their very rapid growth down the styles of unrelated plants.

Even though a variety produces an abundance of pollen it may be safely used as a female parent in crossing if it is self-sterile. The determination of the degree of self-sterility of all cane varieties to be used in the breeding work is therefore desirable, as such information increases the range of

crosses which may be undertaken with certainty as to parentage. Final conclusions as to the degree of self-sterility of a given variety can be arrived at only by selfing tassels from a number of sources and over a period of several seasons. [This paper is to be published in full in *The Hawaiian Planters' Record*.]

ARCHAEOLOGY OF NECKER AND NIHOA ISLANDS

By

KENNETH P. EMORY

An archaeological survey of the uninhabited islands of Necker and Nihoa made by the Bishop Museum in 1923 and 1924 shows that Necker was visited at an early date by people probably from Kauai for the purpose of erecting shrines or performing rites. The culture is southeast Polynesian in ultimate origin, Hawaiian in immediate origin. It is a pure sample of the Hawaiian culture which was almost obliterated about the 13th century by immigrants from the Society Islands, who instituted the historic culture.

Some of the remains on Nihoa Island belong to the same culture as those on Necker, others to the historic Hawaiian culture. The island at one time may have supported a population of more than a hundred, and in later times served as a seasonal visiting ground for fishing and bird collecting expeditions. [This paper has been published in full: *Bernice P. Bishop Museum, Bulletin 53, 1928*.]

THE COEFFICIENT OF ABSORPTION OF A VESICULAR PLASTER

By

IWAO MIYAKE

The most important difficulty in a room with bad acoustics is that of reverberation, or the persistence of sound long after the source has ceased to emit. To remedy the confusion caused by this persistence of sound, it is only necessary to shorten the time of reverberation by adding sound absorbing materials.

Professor Sabine found that the absorbing power of any material of known area changed with the nature of the material as well as the frequency of the sound source. For a given sound source, therefore, the absorbing power of a material is the product of a constant peculiar to it and the area of the material. The constant is known as the coefficient of absorption of the material.

It is the purpose of this paper to add to the list of available coefficients, the coefficient of a vesicular plaster called "Echo-Less." This plaster is applied to the walls like any other plaster. Its particular feature is that it is very porous. It is made so by the gases released by chemical actions between the ingredients of the plaster. The coefficient of a plaster of this nature would, therefore, depend somewhat upon the expertness of application.

The coefficient was deduced from the effect the plaster had upon the time of reverberation of the test room. Three frequencies, F 684 dv/sec, G 384dv/sec, and C# 271 dv/sec, were used in the test and their respective coefficients were 0.15, 0.11, 0.10. The coefficient for frequency 512 dv/sec, was found to be 0.125.

FACTORS AFFECTING THE RATE OF INTERMARRIAGE AMONG
RACIAL OR CULTURAL GROUPS IN HAWAII

By

ROMANZO ADAMS

Some groups, such as the Hawaiian, Part-Hawaiian, Portuguese, and other Caucasian groups, have a higher rate of out marriage than do the Asiatic groups. The causes may be divided into two classes: 1, Those which arise out of preferential attitudes; 2, those that arise out of mere numerical conditions and location—propinquity.

At the present time, the chief factors are social, not racial in the biological sense. The principal social factors determining preference in out marriage are: 1, traditional marriage customs and standards of the various groups; 2, the absence of a common language, an effective barrier to marriage; 3, economic and social status; 4, home life—food, clothing, furniture, household customs; 5, religion.

If two groups such as the Portuguese and the Spanish show a high preference for each other, it may be on account of racial similarity or on account of cultural similarities—religion, language, social status, and marriage customs; there are no data for a decision. But the existence of a higher preference between the Filipino and Portuguese of similar religion than between the Filipino and Japanese with greater racial similarity shows that the culture factor is stronger than the racial factor. The predominance of the culture factor is likewise shown in a greater preference of Chinese and Japanese for Hawaiians or Americans than for each other. Chinese and Japanese are racially similar. Parental control of marriage is an effective bar to intermarriage.

As all the groups acquire the language and other cultural traits of America, the culture factor as affecting attitudes will be less important and it may

be that after two generations the racial factors will be the more important. But by that time the majority of the people will be of mixed race, if present tendencies continue.

EVOLUTION AS A PROBABLE INDEX OF THE RELATIVE AGES
OF PACIFIC ISLANDS

By
C. MONTAGUE COOKE, JR.

The islands of the Pacific belong to three distinct types: the low coral island or atoll; the raised limestone island; the high island, which is composed of volcanic or continental rock. The last type has by far the largest number of endemic land shells. On these high islands have been found eight endemic families of pulmonate land shells, representing ancient stocks that are probably older than the rocks of which the islands are composed. Four of the families are limited to the Pacific, four—two of which are represented in the Carboniferous Era—are of world-wide distribution. As most of the land shells that have evolved on the continents since the Cretaceous Period are absent in the Pacific, it is evident that the means of dispersal existing in ancient times do not exist today.

On each group of islands or on single islands the land shells are strikingly different, as: the Hawaiian islands with 2 endemic families and 21 endemic genera; the Society Islands and Samoa with no endemic families or genera; Fiji with, so far as yet known, 5 endemic genera. Such differences in evolution are probably due to several factors. Of these isolation is important, though the part it plays is in keeping stocks more or less pure. The factor of area does not affect the number of genera inhabiting an island if age is also a factor. For example, the larger and apparently younger island of Hawaii has fewer and less varied forms of land shells than Oahu. But if two islands in a group are of about the same age, the larger island will have more species. Thus in Samoa, Upolu has about nine endemic species and Tutuila, which is smaller, only four. The factor of climate seems not to have much effect on the evolution of land shells. On the other hand, the factor of age seems to be of the greatest importance. As the endemic land shells belong to ancient stocks evolution has been slow, and as evolution apparently has advanced at a uniform rate on each island, the comparative age of the islands can be deduced by the number of their endemic genera and species. Thus the Hawaiian islands, having the greatest number of endemic genera, would seem to be the oldest and to be followed in chronological order by Fiji; Rapa, northwestern Society Islands, and Marquesas Islands; southwestern Society Islands and higher Cook Islands; Samoa; Tonga; Austral Islands; and Mangaia.

THE POISON SPIDER, *LACTRODECTUS MACTANS*

By
NILS P. LARSEN

The spider *Lactrodectus mactans* looks like a black shoe button with a red hour-glass on its abdomen. The largest female seen, measured from toe to toe, 5 cm. It is prevalent in all the southern United States and has been found in the northern ones. Tradition states that the Indians of southern California made emulsions of these spiders to poison their arrow heads. Throughout the United States it is known as the most poisonous of all spiders. Of 150 recorded hospital cases, sent to hospitals because of the severity of the symptoms following a bite, 10 died. So the chance of death from a bite is less than one in fifteen, as only the severest cases are sent to the hospitals.

It has often been stated that poisonous insects brought to Hawaii from the mainland lose their poison. The absence of recorded human cases in the islands, even though the spider is present in fairly large numbers, seemed to lend weight to the "losing poison" theory.

A spider was caught in its natural habitat and after becoming acclimated to the laboratory, several guinea pigs and two rabbits were exposed. The animals were bitten on the nose or ear. Within ten minutes, the first muscular twitchings began to appear, these twitchings continued at rapid intervals, first one part of the body then another being affected. At times the animal would almost jump from the floor. The animals were seen to froth at the mouth and in about half an hour fell over on their sides, semi-conscious and apparently expectantly awaiting death. Gradual recovery would take place and in four to six hours the animals would return to a normal health condition. The back legs were sometimes affected and seemed partially paralyzed.

Eggs were then obtained through the courtesy of Mr. Twigg Smith, and from one egg about 250 small spiders were hatched. From this family, there finally survived one adult female and one adult male. The adult male was placed in a jar with the adult female. There was definite evidence of mutual coyness, none of the quick darting attack evidenced when ordinary prey was thrown into the jar. By next morning the adult male had disappeared. This was in July. In January, the female delivered herself of a large white egg. This was removed to a new bottle on February 1, and on February 27, thinking no live spiders were within, the bottle was opened and a dozen small live spiders hurriedly escaped. There were a large number of undeveloped eggs left behind.

The biting apparatus consists of two saw-toothed prongs, one on each side of the mouth. These two prongs are injected into the enemy, making small holes from which minute drops of blood ooze after the animal has

been bitten. Notes were also made as to why animals were affected differently.

With man the symptoms are very similar. There is a local pain at the time of the bite, followed in about ten minutes by cramping and aching pains, first in the part near the bite and later spreading over the abdomen, legs, back and chest, increasing in intensity for about one hour. The intense agony may last for hours and even large doses of morphine fail to relieve. Nausea, vomiting, and difficulty in breathing accompanies these symptoms. A little temperature develops, the pulse gets slow and the blood pressure rises. Next day the patient may have pains in the feet and legs and complain of numbness in the soles, which lasts for days. The minute drop injected must be very powerful to produce such symptoms. Emil Bogen, in a very interesting article on arachnidism, has described in detail a number of clinical cases and gives an excellent account of spider poisoning.

Some other interesting observations made were the ability of this spider to overcome enemies. A large centipede thrown into the jar was immediately attacked and within a very short time was wrapped up in a tight web. In the same way a scorpion was snared and bitten.

ELECTRICAL ACCIDENTS AND INJURIES

By
GEORGE F. STRAUB

Electrical injuries are all in a class by themselves, being different from any other trauma. The mechanism of electrical accidents is a complicated one inasmuch as many extrinsic and intrinsic factors determine the course and outcome. Significant in this respect are the questions of contact, ground, shoes, clothing, atmospheric conditions, conductivity of the skin, general state of health, and the personality and preparedness of the individual. Although somewhat different in their effect, high and low voltages and direct and alternating currents are equally dangerous. Currents of even less than 1/10 ampere are liable to be fatal. Fibrillation of the heart never having been proved in the accidents under discussion, the electrical death in many cases is only suspended animation, reversible by immediate artificial respiration properly carried out. There is a decided difference in appearance and clinical course between the electrical current mark and the electrical burn, the mark being characteristic for the current effect at the point of contact, the burn differing in no respect from any other burn. Important are the remote effects of the electrical current on the circulatory and nervous systems which are chiefly determined by the resistance and conductivity of the various tissues, the blood being the best conductor. The explanation of the manifold

picture of electrical accidents is furnished in part by the dynamogenic effect, the conduction of the electricity itself, and partly by the psychogenic effect; that is, the conduction of the stimulus caused by the electricity. The modus operandi of the dynamogenic effect is primarily by electronic upheaval in the cell molecules and secondarily by the production of heat, this process being governed by Joule's law. Electrolysis plays a subordinate role. The quality of electrical effect depends entirely upon the effective quantity of the stimulus and the biological response caused thereby and is determined by the biological law of Arndt and Schultz. In parallelism to electrical injuries, death by electricity occurs in four distinct modes: the sudden death, the retarded death, death with a short apparently normal interval, and late death. Immediate artificial respiration will be successful only in a case in which the instantaneous destruction of the current has not affected vital organs. The various phases of the lecture are illustrated by lantern slides.

A FACTOR IN JUVENILE DELINQUENCY

By

ANDREW W. LIND

One of the most important functions of the racial colony in any city is that of providing, during the trying period of readjustment to a new culture and civilization, a haven where the habitual and customary patterns of life are unquestioned and absolute. Within the nondescript and disorganizing slum area of the city, where economic necessity usually compels the immigrant to settle, the racial colony or ghetto serves to conserve and foster the only cultural standards which the immigrant can understand. So, too, for the second generation, caught midway in the assimilative process, the little Tokyo, Chinatown, or little Portugal provide a milieu of stability and accepted values and codes. Unlike the amorphous slum, where all types and varieties of people with as many diverse traditions and moral codes are thrown together in a hopeless welter, the segregated racial colony does preserve one standard of behavior relatively unchallenged. At least the pains of readjustment to the new cultural standards are not nearly so acute as in areas where great diversity of tradition is encountered.

An analysis of the records of the cases appearing before the Juvenile Court of Honolulu in 1927 provides rather striking confirmation of the thesis just stated. For example, it was discovered that in the area of disorganization just back of the city proper, the cases of Japanese delinquency came from neighborhoods where the Japanese were mixed rather indiscriminately with other races, while no cases of Japanese delinquency were reported from an adjoining neighborhood of very high and almost exclusive

concentration of Japanese population. For the city as a whole, we find a rough correlation between social disorganization (measured in terms of juvenile delinquency) and the degree of segregation and concentration of the population of the various immigrant colonies. Our data seem to show that "the children of the ghetto," to use Zangwill's phrase, are less likely to run afoul of the American law than their cousins who have escaped from the colony.

VITAMIN CONTENT OF SOME ORIENTAL FOODS

By

CAREY D. MILLER, DORIS B. HAIR, AND MARJORIE G. ABEL

The vitamin content of two of the cheapest and most used Oriental vegetables in Honolulu, green gram bean sprouts (*Phaseolus aureus* or *Phaseolus mungo*) and Chinese cabbage (*Brassica chinensis*) have been determined, using Sherman's quantitative method.

The vitamins A, B, and C of raw and cooked bean sprouts were determined by feeding experiments on 65 rats and 20 guinea pigs. The cooked sprouts were steamed for five minutes so that they remained slightly crisp. Compared with some other common vegetables, they have been shown to be a fair source of vitamin A in both the raw and cooked state; a very good source of vitamin B, both raw and cooked; and an excellent source of vitamin C in the raw state and a good source in the cooked.

Preliminary work on the Chinese cabbage showed that the green leafy portion was high in vitamins A and B, whereas the white petiole and rib was extremely poor. In the quantitative experiments the entire cabbage was fed in the raw state, steamed ten minutes and salted in the usual Japanese manner. This cabbage is used much more by the Japanese than by the Chinese. Compared with other vegetables, the Chinese cabbage has been shown to be rather a poor source of vitamin A with considerable loss of the vitamin through cooking and salting; a fair source of vitamin B, with some loss through cooking and more when salted; and an excellent source of vitamin C when raw, a good source when cooked, and a very poor source when salted.

PALMS IN TROPICAL FORESTS

By

HAROLD S. LYON

The forestry problem in Hawaii is to cover grass lands with forests, and if we could learn how this is accomplished by nature in other parts of the

tropics, we might contrive to start a similar sequence of events here, and then leave it to nature to carry on the work for us.

In north central Trinidad is a grass covered area of considerable extent known as the Aripo Savannah. It lies on a sandy flood plain of compact, barren soil, in which the water table is only a few inches below the surface. This savannah is surrounded by forests. Within the savannah itself are islands or oases of forest. It is evident that the savannah along its margin is being encroached upon by the forest, that forest components are becoming established at points well within the savannah, and from these foci islands are built up. This savannah furnished examples of islands of all sizes, making it possible to trace the sequence of events from the inception of the focus to the completion of an island many acres in extent.

The moriche palm is the originator of many of these islands. Because of its ability to withstand the vicissitudes of soil and climate on the open savannah, it is able to establish itself in competition with the grasses. Growing in the savannah, it creates about itself conditions which make it possible for other trees and shrubs to grow beside it. This society thus started continues to improve conditions in its immediate environment, which makes it possible for additional plant forms to enter the society, and thus the complexity of the organization grows. Eventually conditions are created which make it possible for the more exacting rain forest trees to enter the formation. Once established within the formation, these trees and their associates soon take possession and create conditions under which the palms and other pioneer plants in the forest building are at a disadvantage, and consequently the pioneers are forced into a secondary position, or eliminated altogether.

At another point in Trinidad, we followed the transition from savannah to forest with another species of palm, the Cocorite, acting as the pioneer. This palm invaded the savannah and became the nucleus of a forest oasis.

These observations lead to the belief that certain palms can be used to advantage in starting forest formations on denuded areas in Hawaii.

EDUCATIONAL RECREATION IN HAWAII

By
E. H. BRYAN, JR.

Educational recreation was defined as the constructive, or beneficial, use of leisure time. A brief enumeration was given of the organizations in Honolulu carrying on or encouraging such leisure time activities. Among these were mentioned the Recreation Commission, the Boy Scouts, the Girl Scouts, the Y.M.C.A., the Y.W.C.A., the Y.M.B.A., the Boy's Work Council, the Girl's Work Council, Palama Settlement, the Trail and Mountain Club, the Outrigger Canoe Club and various other swimming and rowing organiza-

tions, the Amateur Athletic Union and other athletic associations, the many extension and night classes, the Honolulu Academy of Arts, the public libraries, different racial group organizations, the Aquarium, Bernice P. Bishop Museum, the Pan-Pacific Research Institution, several scientific societies, and civic and religious organizations.

A series of lantern slides, loaned by the American Museum of Natural History, New York, were shown of various educational and recreational activities not as yet carried on in Hawaii. These include circulating natural history collection service for the schools, nature trails, and "visual" education by the touch examination of specimens for the blind.

A QUANTITATIVE STUDY OF THE RAINFALL OF OAHU

By

J. F. VOORHEES

An attempt has been made to determine the total quantity of rainfall in Oahu, and to consider briefly what becomes of it. Rainfall data were available for 88 stations well distributed over the island. The records for 12 of these stations were longer than 30 years, 26 were from 21 to 30 years, and 20 from 10 to 20 years in length. The data were platted on a map of the island and isohyetal lines drawn for each 20 inches. The data indicated that elevation might properly be ignored in drawing these lines, a conclusion strengthened by two correlations that were computed. The first, between elevation and rainfall gave $r = .21 \pm .13$ and the second gave $r = .81 \pm .04$, indicating that distance from the crest of the range was a far more important factor than the elevation in determining the amount of rainfall at a station. The elevation of the crest over which the wind blows determines the amount of condensation, and not the elevation of the point at which the rain reaches the earth. The areas between the lines were measured and the number of square miles in each multiplied by the depth in inches giving the number of square mile inches. The total for Oahu was 40889 sq.mi.in. which, divided by the number of square miles gives an average depth of 68.4 inches, which amounts to 713,000 million gallons.

Assuming from certain considerations that 10 to 15 per cent evaporates from vegetation, and that 35 to 40 per cent is lost to the air by transpiration, there is left about 50 per cent of the total rainfall that escapes to the sea by surface runoff or through the artesian basins. The surface runoff has been previously calculated to be about 30 per cent of the total rainfall. The Honolulu Sewer and Water Commission gives 42 million gallons daily as a safe limit for pumping in the Honolulu district. This amount is just about 20 per cent of the rainfall in that area. Because the artesian basins are

probably all being pumped to capacity, any addition to the available water supply must be taken from the 30 per cent that now escapes to the sea as surface runoff, or through springs near sea level.

THE PROPAGATION OF INDIGENOUS TREE SEED

By

C. S. JUDD

The indigenous Hawaiian trees, with certain exceptions, are not readily or easily handled on a large scale in tree nursery or planting operations in the forest reserves of the Territory of Hawaii.

The koa stands out as an exception. As a seedling its growth is rapid but its seed is almost universally riddled by a moth borer. Also the tree thrives only on well-drained soil. The hau, though satisfactory and readily propagated from slips, has its altitudinal limitations. The *nilo*, *kamani*, coconut, hala, and *kou* germinate well, but are littoral trees and hence are not suitable for forest reserve plantings, though their seeds germinate well. The mountain apple, like the kukui, thrives only in moist bottom land and the *wilwili*, only in the dry soil of the foothills. The *ohia lehua* is most difficult to raise from seed, is very slow growing and is essentially a wild tree. The *alahee* seed is also almost always infested by a borer.

It would seem that entomologists could be of great assistance in providing more effective natural enemies of these seed infesting insects so that the koa, *alahee*, and other native trees could reproduce themselves more widely by natural seeding.

A more general use of sandalwood is desirable. Before this can be done much more must first be learned about its parasitic habits.

A preliminary study of the germination and growth of six indigenous forest trees and of six introduced trees shows that the native seed has an average germination per cent which is more than twice as high as that of seed of the introduced trees. The native trees, however, require a period almost twice as long for growth to the stage when they are ready for transplanting. [This paper is published in full in *The Hawaiian Forester and Agriculturist*: vol. 25, no. 4, 1928.]

INFLUENCE OF NITROGEN FERTILIZER ON THE SUCROSE CONTENT
OF SUGAR-CANE

By

W. P. ALEXANDER

A study was made at Ewa plantation of 74 nitrogen field experiments to determine under the local environmental conditions the effect of different

amounts of nitrogen on sucrose content; the effect of different times of application on sucrose content and whether a better control of nitrogen fertilization could lessen the depression upon sucrose content.

In a paper presented before the Academy two years ago on "The influence of potash fertilizer on sucrose content of the cane" it was shown that, contrary to published data, under certain conditions potash fertilizer has a beneficial effect on the sucrose content of cane. However, with nitrogen applications in general, the reverse is true. More cane per ton of sugar is required when cane is fertilized with nitrogen to offset the depressing effect on sucrose content. This depressing effect varied greatly, averaging about 2 per cent for each additional 50 pounds of nitrogen with a standard deviation of ± 2.3 .

The why and wherefore of this lack of regularity in the influence of nitrogen upon the sucrose content was investigated. First there seemed to be some indications that as the nitrogen applications over 150 pounds per acre increased, the loss in sucrose content decreased. The average data may be presented as follows:

When an extra dose of 50 pounds is added

to 250 lbs. P. A. the loss was 1.5 per cent.

to 200 lbs. P. A. the loss was 2.3 per cent.

to 150 lbs. P. A. the loss was 2.9 per cent.

In other words, assuming a quality ratio¹ of 8 with 150 pounds nitrogen

200 lbs. P. A. nitrogen=8.30 Q. R. Difference 0.30 Q. R.

250 lbs. P. A. nitrogen=8.50 Q. R. Difference 0.20 Q. R.

300 lbs. P. A. nitrogen=8.63 Q. R. Difference 0.13 Q. R.

These are very general figures showing as the amount of nitrogen is increased above a certain point, the detrimental effect is less. There is a great deal of fluctuation between individual tests. An effort was made to correlate the differences in per cent loss in sucrose content due to nitrogen applications with the following factors:

1, soil type; 2, date of harvest; 3, degree of ripeness at harvest; 4, age of cane at harvest; 5, proportion of nitrogen applied between first and second seasons; 6, interval between last fertilization and harvest; 7, fertility of soil as shown by yield—cane per acre per month.

The juice of cane grown on the pali and coral soil types was less influenced by nitrogen applications. When cane was harvested at the time when it ripens normally—that is, in May—the juices were better, irrespective of nitrogen treatment. Conversely, cane harvested in the early season suffered more from added nitrogen.

¹Theoretical tons cane per ton sugar required

Extra cane yields, usually offset the lower juices when the 150-pound dose was boosted to 200 pounds, often compensated for the poorer quality ratio in the jump from 200 pounds to 250 pounds and seldom counterbalanced the reduction in sucrose content when 300 pounds was applied.

The key to profitable fertilization with heavy doses of nitrogen is application at the proper time. There is a point in the cane's growth when no further nitrogen or only small quantities can be applied with safety. Great care must be exercised not to give the cane overdoses in the second season. [This paper is published in full in the Hawaiian Planters' Record, July, 1928.]

THE RELATION OF ATYA TO ORTMANNIA HENSHAWI

By

CHARLES H. EDMONDSON

Three species of fresh water shrimps of the family Atyidae have been recognized in Hawaii. The species *Caridina brevrostris* is the most primitive.

The species *Ortmannia henschawi* and *Atya bisulcata* differ primarily in the character of their chelipeds. The species *Ortmannia henschawi* possesses a palm, the dactylus being shorter than the propodus, and the wrist, or carpus, of the second cheliped is longer than that of the first. In *Atya bisulcata* the dactylus and propodus are of equal length, thereby eliminating the palm of the hand, while the carpus of the second cheliped is short like that of the first. The tufts of bristles directed forward from the pincers of the chelipeds are longer in *Atya* than in *Ortmannia*.

Of many hundreds of young hatched from eggs of *Atya bisulcata*, all were *Ortmannia henschawi*. Practically all immature and many mature specimens of *Atya bisulcata* were, upon removal and regeneration of the chelipeds, converted into *Ortmannia henschawi*. By the same process, *Ortmannia* may be transformed into *Atya*, the change being made, however, in not more than 10 per cent of the specimens tested, the older animals showing the greater tendency to change.

Investigations in progress aim to determine the character of the young hatched from the eggs of *Ortmannia*; to ascertain the number of chromosomes in the germ cells of *Atya* and *Ortmannia*, and test their interbreeding. Assuming that the young of both forms are at first *Ortmannia* like, an attempt is also being made to learn at what stage and by reason of what stimulus the transformation to *Atya* may take place. [This paper is in preparation for publication by Bernice P. Bishop Museum.]

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