PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

SEVENTH ANNUAL MEETING

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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 1931-32, one special public lecture was held, in cooperation with the Extension Division of the University of Hawaii, when Dr. Richard Woltereck of the University of Leipzig spoke on "The differentiation of species and of races in islands and lakes." (January 26, 1932.)

The sessons of the Seventh Annual Meeting were held in Dean Hall, University of Hawaii, May 4 to 7, 1932, ending with a banquet at the Pacific Club.

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PROGRAM OF THE SEVENTH ANNUAL MEETING

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

Preliminary announcements.
Election of members.
Appointment of committees.
Presentation of papers:
Mr. C. S. Judd: The parasitic habit of the sandalwood tree.
Mr. G. W. Duss: Notes on the distribution of Neowawraea.
Dr. Harold St. John and Mr. E. Y. Hosaka: Noxious weeds of the Hawaiian pineapple fields. (Presented by Dr. St. John.)
Mr. W. C. Davis and Dr. O. N. Allen: Observations on the Myxomycete flora of the island of Oahu. (Presented by Mr. Davis.)
Dr. J. L. Collins: Polyploidy in pineapples.
Dr. C. P. Sideris and Miss B. H. Krauss: Physiological studies on pineapples.
Mr. Otto Degener: A new illustrated flora of the Hawaiian Islands.

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

Presentation of papers:
Dr. H. S. Palmer: An odd detail of weathering of pahoehoe lava.
Mr. C. B. Andrews: The mechanics of soils.
Mr. H. A. Wadsworth: Some factors affecting the moisture equivalents of soils.
Dr. C. H. Edmondson: Quantitative studies of the copepod fauna on local shores.
Dr. F. X. Williams: Water-loving insects of Hawaii.
Dr. R. N. Chapman: An experimental study of insect populations.
Mr. K. P. Emory: A comparison of the maraes of Tahiti and Necker Island.

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

Presentation of papers:
Dr. E. D. W. Brown: Is there an Indo-Malayan element in the pteridophyte flora of southeastern Polynesia?
Dr. F. B. H. Brown: Notes on the dicotyledons of southeastern Polynesia.
Dr. J. W. Coulter: Land utilization in the Hawaiian islands in 1930.
Mrs. M. G. Abel and Miss C. D. Miller: The vitamin content of Chinese cabbage (*Brassica chinensis*). (Presented by Mrs. Abel.)
Miss C. D. Miller: Studies of the nutritive value of the opihi (*Helcioniscus exaratus* and *H. argentatus*).

Miss M. D. Vernon: Scenes from the life of Edison.
Mr. R. J. Baker: Biological Records by means of motion pictures.

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

Mr. G. C. Munro: The rotation and distribution of plants. (Read by the Secretary.)
Mr. d'A. A. Welch: The locomotion of gastropod molluscs.
Dr. Madorah E. Smith: The influence of age, sex, and situation on the frequency, form, and function of questions asked by pre-school children.
Dr. Romanzo Adams: Racial "passing over" in Hawaii.
Dr. A. W. Lind: A measure of issues in Hawaiian elections.
Dr. Harald Wülffing: Der Wohnungsmangel und seine Bekämpfung. (Read by title.)

SATURDAY, MAY 7, 6:45 P. M.

Pacific Club banquet.
Constitutional order of business.
Installation of new officers.
Presidential address: Some personal correspondence.
Adjournment.

ABSTRACTS OF PAPERS

SOME PERSONAL CORRESPONDENCE
(Presidential Address)

By

HAROLD L. LYON

The Presidential Address, unfortunately, does not lend itself to successful abstraction, and it is not feasible to present it in its entirety. It consisted of the reading of some correspondence between Dr. Lyon and a missionary in India, arising from a discussion between them on shipboard enroute from Penang to Calcutta. This discussion of the relationship between dogmatic religion and modern science led to a very clearly defined and carefully worded statement of his personal scientific philosophy, which Dr. Lyon had prepared for the enlightenment of the ecclesiastic, and which made up the body of the address.

THE PARASITIC HABIT OF THE SANDALWOOD TREE

By

CHARLES S. JUDD

The *laau ala* or fragrant heartwood of the sandalwood tree enabled the first king of Hawaii to start a profitable trade with China with such success that in one generation he succeeded in leading his people from barbarism to civilization.

The sandalwood trade was at its height from 1810 to 1825 and ceased in 1840. It led to extravagant spending on the part of the king, and to oppression of the common people and to the decimation of all the large trees in the islands, and finally ended in Boki's disastrous expedition to Eromanga from which only 20 people returned out of the 500 who originally set out.

Contrary to general belief, the sandalwoods in Hawaii were not exterminated but are still found on all the larger islands. Though in India there is only one species, which produces probably the most valuable wood in the world, botanists recognize in Hawaii 8 distinct species and 3 varieties.

The commonest species (*Santalum freycinetianum*) is rather small and insignificant with curling leaves and brittle, drooping branchlets, and grows very slowly in well drained soil in the drier regions. The only fragrant part of the tree is the oily heartwood.

Very little is known about the parasitic habit of the Hawaiian sandalwoods but studies made in India throw considerable light on the subject. The actual transference of sap is made by means of a sucking organ, the haustorium, which attaches itself to the root of the host and by breaking down the cortical cells makes direct connection with the fibro-vascular cylinder and transfers the stream of salts and water through vascular strands to the sandalwood. Studies now being conducted in Hawaii aim to determine whether the Hawaiian species are true parasites and how they may be propagated successfully and in quantity. (Illustrated with slides and growing specimens.)

NOTES ON THE DISTRIBUTION OF NEOWAWRAEA

By

GLEN W. RUSS

In 1912 J. F. Rock discovered on the island of Hawaii three trees which he considered representatives of a new genus, and which he described as *Neowawraea phyllanthoides.* These trees have been rediscovered with others in the same locality, and more have been found on Oahu and Molokai. The species should occur on Maui and Kauai as well. It is the most impressive tree in the Hawaiian forests, the largest one known on Oahu having a trunk circumference of 37 feet. The wood is impregnated with oil, hard, durable and straight grained. The sapwood is white and the heartwood rich brown. As now known the tree is restricted to the upper forests of the Waianae Mountains of Oahu, except for the five or six trees on Hawaii and one on Molokai. In all about 25 living trees are known, most of them overmature. Large numbers of logs lie strewn over the ground in the Waianae Mountains, showing that not over 200 years ago the species was an important member of the Waianae forests.

The species is of a very elemental type and became decadent probably through changing climatic conditions to which, like many relic species, it was unable to adapt itself. The introduction of new animals and weeds into the forests has broken up the balance which the species had maintained, and started the submergence of the less vigorous.

Rock classed *Neowawraea* as being closely allied to *Phyllanthus* or *Bischofia,* but more recent studies of its characters, with fuller material, show it to be congeneric with *Drypetes,* a genus of probable African origin which is distributed throughout South Africa, Malaysia, the Philippines, the West Indies and tropical America.

The ancestors of the Hawaiian plants must have arrived here in very

remote times, as the climatic conditions of the shores today could not sustain them. But that conditions suitable for their reception existed here ages ago is shown by the presence of fossilized wet forest plants intermingled with shore rushes, in situations very little above sea level. This time was possibly during some of the early periods of glaciation.

Unless aided by human agencies the species will soon become extinct. Such aid is now being given and healthy young trees are already growing in the Territorial Nursery. (Illustrated with slides and growing plants.)

NOXIOUS WEEDS OF THE HAWAIIAN PINEAPPLE FIELDS

By

HAROLD ST. JOHN and EDWARD Y. HOSAKA

The study of weeds is not new; it is as old as agriculture. A weed is a plant out of place—that is, from man's point of view. The grower of pineapples has to fight these invaders in his cultivated field and he tries to prevent the weeds from taking possession of the field. He needs to know the duration of the particular weed, whether short-lived or long-lived; its propagation, whether by seed, by runners, or by underground root-stocks; its nature of growth; and the frequency of new generations.

Several important agents serve to spread the weeds in the fields. Wind blows the seeds of many, as the Horseweed (*Erigeron canadensis*) and the Red Pualele (*Emilia sonchifolia*). Man, while walking in the fields, carries the burs of weeds, such as the Sand-bur (*Cenchrus echinatus*) and the Bristly Foxtail (*Setaria verticillata*), later brushing them off. Horses spread the same burs or bristly fruits, like the Spanish Needle (*Bidens pilosa*). Birds eat the berries and scatter the seeds of plants like the Popolo (*Solanum nodiflorum*) and the Lantana (*Lantana camara*). The planting materials, the pineapple crown, slip or shoot carry weed seeds with them to new fields. The pineapple boxes in their journeys from the field to the cannery and back, often to another field, serve as efficient carriers and disseminators of weed seeds.

The study revealed 83 noxious weeds. Of this total only 5 are indigenous to Hawaii and of these only 1 a probable endemic. The others are all adventives: 15 from the Pacific islands and southern Asia, 11 from Eurasia and Africa, 29 from tropical America, and 23 widely distributed throughout the tropics. Thus the noxious weeds of the Hawaiian pineapple fields are nearly all foreign invaders. (Illustrated with lantern slides.)

OBSERVATIONS ON THE MYXOMYCETE FLORA OF OAHU

By
W. C. Davis and O. N. Allen

The Myxomycetes, commonly called Slime Molds, constitute a group of minute, non-chlorophyllaceous organisms reproducing by either exogenous or endogenous spores. These spores upon germination produce either ciliated or non-ciliated zoospores which in turn develop into swarm-spores. The coalescence of these swarm-spores gives rise to the plasmodial stage. The Myxomycetes are generally considered as a borderline group between the plant and animal kingdoms. The forms are widely distributed throughout the world, and decaying plant material under moist conditions provides a very suitable sub-stratum for their growth.

Only five species representing four genera have been previously described for the Territory of Hawaii. To date the authors have identified thirty-four species representing twelve genera from collections made in various localities of the Waianae and Koolau mountain ranges of Oahu. Dr. C. L. Shear has recently contributed to this study a collection of unidentified Hawaiian Myxomycetes which were collected on Oahu several years ago. These forms have previously been included in the herbarium of the United States Department of Agriculture.

Each species is being studied from the standpoint of habitat, relative abundance, and type of original sub-stratum as well as from taxonomic characters. Attempts are being made to trace the entire life cycle of some of the species by means of growth on artificial culture media and permanent histological slides of the developing stages. (Illustrated with lantern slides and specimens.)

POLYPLOIDY IN PINEAPPLES

By
J. L. Collins

The normal somatic chromosome number in *Ananas sativus* Lindl. and in *Ananas microstachys* Lindm. is 50, and the gamete number is consequently 25. Triploid pineapples containing 75 chromosomes in the somatic nuclei have been found in hybrid populations. Most of them were in the F_1 hybrid produced by crossing the two species mentioned above. It has also been shown that the Cabezona, a variety grown commercially in the West Indies, is a triploid with 75 chromosomes.

The triploids are larger and more robust than the comparable diploid forms. This increased size is especially noticeable in leaf length, leaf width, fruit weight and pollen grain size and in the slower rate of maturity.

The pineapple triploids originated from the union of diploid egg gametes with normal haploid pollen gametes. Diploid egg gametes might arise either from non-reduction of the egg mother-cell or a doubling of the chromosome number in the nucleus following the heterotypic division. The former method was operative in the cases described here. The conclusion is based upon both genetic and morphological evidence. Cayenne, the female parent, is heterozygous for the dominant character smooth leaves, while the male parent, *A. microstachys,* is homozygous for the recessive allelomorph spiny leaves. In the population of diploid hybrids resulting from this cross half have spiny leaves and half have smooth leaves. If the diploid egg gametes had formed by a doubling of the chromosomes following the heterotypic division the same ratio of smooth to spiny leaved triploid plants should have been produced; however, all the triploids have smooth leaves, which indicates that they originated from non-reduction and that the 50 diploid Cayenne and 25 Wild Brazil chromosomes are present in these triploids.

Gametogenesis in the triploids is a very irregular process. During diakinesis varying numbers of trivalent, bivalent and univalent chromosomes are found in different pollen mother-cells of the same plant. The chromosomes at the metaphase are scattered irregularly along the spindle. During the anaphase many lagging chromosomes are observed but they eventually reach the poles and are included in the new nuclei formed at the end of the telophase. No micronuclei or microcytes have been found. The two meiotic divisions are completed with the formation of tetrads which appear to be normal. Development of the pollen grain subsequently, however, is quite abnormal; many of the microspores become evacuolated, shrink in size, and finally collapse into flat empty exine membranes showing no visible protoplasmic contents. The microspores which escape this fate produce pollen grains varying greatly in size. A small percentage of this pollen is functional when used on the Cayenne parent. When the triploid was used as a female parent no viable seeds resulted.

The discovery of triploid pineapple plants is a highly significant event with implications of greatest importance for pineapple breeding. (Illustrated with slides and charts.)

A NEW ILLUSTRATED FLORA OF THE HAWAIIAN ISLANDS

By
OTTO DEGENER

As real need exists for an up-to-date comprehensive flora of Hawaii, the writer decided to produce a "Flora Hawaiiensis." This is to contain all pertinent previous knowledge concerning local ferns and flowering plants as

well as put into convenient form the final results of present and future investigations. This will be issued in fascicles consisting of approximately 100 plant descriptions and 100 full-page plates. These fascicles, by means of an ingenious yet simple method, will permit the binding of new pages of descriptions in taxonomic sequence rather than in chronologic order of publication. Thus this flora, which is intended to displace all other taxonomic works used by the general botanist and layman, will always remain the "New Illustrated Flora of the Hawaiian Islands."

With this purpose of producing a "Flora Hawaiiensis," the writer began collecting and critically studying Hawaiian plants in 1922. Though modestly disclaiming all responsibility, this work was stimulated in an unusual way on recommendation of the Director of Bishop Museum. During the last decade the writer spent a year studying Hawaiian collections at the New York Botanical Garden and botanized extensively in Hawaii, devoting in the aggregate over two years in the field. He has employed at least one native collector since 1926 to help gather material and from one to as many as four illustrators to draw the rare plants discovered. As a result he now possesses the largest private herbarium of Hawaiian plants in existence and over 500 carefully executed drawings.

The first fascicle of the "Flora," privately printed, is now in press. Succeeding fascicles will quickly follow as the writer is taking his entire herbarium to American and European botanical centers for study and comparison with historical Hawaiian collections, an opportunity not so readily available elsewhere. (Illustrated with specimen plates.)

AN ODD DETAIL OF WEATHERING OF PAHOEHOE LAVA

By
HAROLD S. PALMER

During a recent study of the shores of the island of Hawaii, with Dr. Howard A. Powers of the Hawaiian Volcano Observatory, we repeatedly noticed blocks of pahoehoe lava on the surface of which were roughly circular pits 1 to 2 inches across and 1 to 2 inches deep. The pits lie at intervals of a couple of inches along arcuate, subparallel lines. A first guess as to their origin ascribed them to the work of sea urchins, which are well known to bore pits into rocks. However, sea urchins make larger holes and space them more irregularly, so this hypothesis was abandoned. Then it occurred to Mrs. Palmer, who also saw them, that they might be some sort of primitive playing board such as the *papamu,* but this hypothesis had also to be abandoned but for opposite reasons—the pits are not regular enough in any one slab and no one slab is like any other slab.

The key, in the form of a genetic series, was stumbled onto on a young pahoehoe flat a little north of Hookena, where the lava has been scaled away to varying degrees. The origin seems to be as follows: When pahoehoe lava is in slow motion the drag of the still liquid interior wrinkles the crust into the subparallel, arcuate folds that characterize the so-called "ropy" lava. Each wrinkle is 1 to 4 inches high and 2 to 10 inches wide in general. The gas rising through the lava cannot escape through the solidified crust of the wrinkles and is trapped beneath a long arch. Various small bubbles combine to form large bubbles. The crust above the bubbles is rather glassy and, on exposure, wears away more rapidly than does the stonier lower lava. Thus the pits represent the lower parts of the large bubbles. The arcuate arrangement of pits reflects the arcuate course of the wrinkles. The uniformity in size and spacing is due to the uniformity of the physical properties of the lava. At the key locality half a dozen stages were found that range from complete pahoehoe wrinkles through partly exposed bubbles to typical pitted surfaces. (Illustrated with slides and specimens.)

THE MECHANICS OF SOILS

By

CARL B. ANDREWS

The classical earth pressure theories of Coulomb and Rankine have given results so much at variance with results obtained in practice, that further investigations of phenomena of soil movement have been undertaken on the basis of the laws of physics.

The engineering problems in soils are: 1, the bearing value of soils; 2, the pressures against retaining walls; and 3, the stability of earth slopes with respect to sliding. While the classical earth pressure theories, for the sake of simplicity, were based on the assumption that the soil under consideration was a loose granular mass, possessing friction but devoid of cohesion, the newer theories have taken into account the cohesion which is present in all soils except those made up of granules of somewhat large size, such as sands and gravels. The presence or absence of water in the pores of the soils makes a great difference in the soil behavior. The more fine-grained soils, such as clays and muds, shrink when dried and expand when wet to a marked degree, and it has been found that pressures on walls, when backfilled with materials of these sorts, is likely to be due to expansion because of the presence of water, rather than to the weight of the retained material. In slides of earth, it has been shown that whereas cohesionless soils will stand at the "angle of repose" to any desired height, soils which depend on

cohesion rather than on friction for their stability require a flatter slope for a high embankment than for a low one, for the same factor of safety against sliding.

The fine-grained soils of Hawaii differ from corresponding soils of temperate regions in having a greater void volume, and both Hawaiian laterites and mainland clays show properties resembling the elastic properties of solid bodies.

SOME FACTORS AFFECTING THE MOISTURE EQUIVALENTS OF SOILS

By

HAROLD A. WADSWORTH

That the moisture equivalents of soils are closely correlated to the percentages of colloidal materials in them has long been recognized, but minor departures from direct proportionality have so far been disregarded. Recent chemical analyses of specimens of extracted colloid from widely separated soils permit a closer study of this relation.

Although many materials may be present in a soil colloid, the larger part is composed of SiO_2, Al_2O_3, Fe_2O_3 and organic matter. If the molar ratios of these mineral materials reported in a recent government paper be compared with the moisture equivalents which are given, one may secure a correlation coefficient of $+0.732$ for the $\frac{SiO_2}{Al_2O_3}$ ratio and $+0.751$ for the $\frac{SiO_2}{Al_2O_3 + Fe_2O_3}$ ratio. This procedure, however, is faulty on two scores: first, the organic matter is ignored, and second, it is tacitly assumed that Al_2O_3 and Fe_2O_3 have the same inherent water-holding capacity.

More refined interpretation by the method of least squares permits the evaluation of the potential water-holding capacity of each of these materials. When this is done a correlation coefficient of $+0.850$ is secured between the computed moisture equivalent and the observed moisture equivalent.

The assumption that SiO_2 and Al_2O_3 act as entities in the colloidal material needs justification. Arbitrary groupings of these two materials into alumino-silicates ranging from $4\ SiO_2 \cdot Al_2O_3$ to $SiO_2 \cdot 4\ Al_2O_3$ fails to change the correlation coefficient.

The conclusions from the work to date would indicate that the water-holding capacity of a colloid depended upon its percentage composition of SiO_2, organic matter, Fe_2O_3, and Al_2O_3, the decreasing significance of these materials in affecting the moisture equivalents being in the order given. (Illustrated with charts.)

QUANTITATIVE STUDIES OF THE COPEPOD FAUNA ON LOCAL SHORES

By

CHARLES H. EDMONDSON

An attempt is being made to correlate the abundance or paucity of copepods with the growth of organisms which depend more or less directly upon these minute crustaceans for food.

Stations have been established on both the windward and leeward sides of Oahu. The base station A is on Waikiki reef, near the Marine Biological Laboratory. Station B and six substations are also on Waikiki reef. Pier 2 at the entrance of Honolulu Harbor is another station and collections are frequently taken at the navy pier in the middle loch of Pearl Harbor. Kaneohe Bay has been the center of investigations on the windward side of the island.

Collections were more frequent at Station A, because of its convenient locality, averaging three or four daily. Occasionally collections were made hourly for 24 consecutive hours. Results for a period of 8 months, September to April, inclusive, may be summarized as follows:

A remarkable paucity of copepods is observed in the shoal waters of Waikiki reef, the maximum count being 90 per 11 liters of water, the unit of measurement. Here two peaks are usually noted daily, an early forenoon peak (6 to 8 o'clock) and an early evening peak (6 to 8 o'clock). In the early afternoon, especially on clear, warm days, the number falls to a minimum. Few copepods are in circulation in the shoal water during high tide. During this period the number of copepods reached a minimum at Station A in January, the maximum count for this month being 11 per unit. Substations farther out on Waikiki reef show a slightly higher count than at Station A, but in no case did they exceed its peak of 90 per unit.

At the Pearl Harbor station the number of copepods per unit of surface water is seldom less than 1000, and frequently ranges between 3000 and 4000. On a clear, hot afternoon the number at the bottom may be twice as great as at the surface.

At Pier 2 the count is usually under 100 per unit of surface water. During the afternoon 10 times as many copepods may be found at the bottom as at the surface.

Copepods seem to be more abundant in the waters of Kaneohe Bay than at other localities about Oahu, the maximum count for surface water being 8083 per unit. A larger number is found over the deep channels than over the shoal sand-covered areas, especially at low tide, due probably to the intensity of reflected light.

Six or eight species seem to make up the copepod fauna of the shoal waters about Oahu, but determinations have not yet been made. The responses of

the different forms of copepods to various ecological factors under laboratory conditions are being studied. (Illustrated with charts.)

WATER-LOVING INSECTS OF HAWAII

By

FRANCIS X. WILLIAMS

Here are included insects that spend at least a part of their existence in the water or on its surface. The Hawaiian fauna of this type is rather poor except in damsel flies (*Agrionidae, Odonata*).

Such adult insects here that float on the surface film of water use chiefly the middle pair of legs for support and propulsion; those adult insects that swim in the water depend more or entirely on the last pair of legs for propulsion.

Dytiscid beetles swim with simultaneous strokes of the hind legs, hydrophilid beetles with alternate strokes; the dytiscid (*Rhantus*) larva devours its prey submerged, the hydrophilid (*Hydrobius*) holds its prey more or less out of the water; the hydrophilid larva is a poor swimmer and swallows air to insure buoyancy.

Hydrophorus praecox, an immigrant lowland surface-skating dolichopodid fly, is carnivorous as larva and adult, devouring blood-worms, etc. The larva pupates in a cocoon. *Brachydeutera hebes,* apparently endemic, is a very adaptable ephydrid fly that laps its food from the surface of the water; its larva swims, and is phytophagous and a scavenger. A somewhat canoe-shaped puparium is formed. A large psychodid fly, *Telmatoscopus albipunctatus,* seems a recent arrival here, and breeds in mud and water pockets in trees. The larva does not swim. The mosquito-like midge, *Chironomus hawaiiensis,* is harmless. The eggs are laid in gelatinous masses in the water, and the larvae are called blood-worms.

Anax strenuus is a very large native dragonfly, living chiefly in the mountains. *Pantala flavescens,* the common brown dragonfly of the lowlands, is not native. Some damsel flies (*Agrion*) breed at the leaf bases of Astelia and Freycinetia.

A corixid bug inhabits quite salty water; a back-swimmer bug (*Buenoa*) lives in fresh water and feeds on mosquito larvae, etc. We have two very small fresh-water-strider bugs. The marine water-strider bug (*Halobates sericeus*) is wingless and very fast. It is sometimes beached in great numbers during Kona storms. (Illustrated with slides.)

AN EXPERIMENTAL STUDY OF INSECT POPULATIONS

By
ROYAL N. CHAPMAN

The problem of animal populations in general has been of interest to mathematicians and biologists. Some have viewed the problem essentially as the Platonic school of Greek philosophers looked at natural laws in general, as purely mathematical phenomena. These students have considered their hypotheses as of more value than data on populations because the data may be incomplete, while their hypotheses are based on natural laws. The more typical biologists consider the factors influencing the population to be too involved to be susceptible to careful analysis. They are content to deal with broad generalizations.

A study of the confused flour beetle, *Tribolium confusum,* has demonstrated that it is possible to maintain these beetles under natural conditions and to measure experimentally the effects of physical and biotic factors of the environment on the population. This method has shown that physical factors may have a very definite influence on the rate at which the population curve attains its asymptotic value; and that such biotic factors as parasites may thereafter cause fluctuations of regular sequence and amplitude. Both the experimental conditions and the method of measuring the population can be reduced to great precision. (Illustrated with charts and a demonstration.)

A COMPARISON OF THE MARAES OF TAHITI AND NECKER ISLAND

By
KENNETH P. EMORY

The stone shrines or maraes of Necker Island form the most convincing evidence so far uncovered of an ancient cultural contact between Hawaii and the Society Islands.

This type of marae, although it has disappeared elsewhere in Hawaii, reappears in the extreme eastern part of the Tuamotu Archipelago. In the western part of the Tuamotus and in the adjacent Society Islands there exists a very similar marae, apparently derived from it, which has undergone considerable elaboration in the Society Islands during the last twenty-five generations.

The only important difference between the early Society Islands marae and the Necker marae is in the number and arrangement of the stone uprights along the back and against the front of the platform. In Tahiti, the rear uprights consist of a central upright and, in some, one upright at each

end also. On Necker there are a number of uprights on one side of the central one and an equal number on the other. In Tahiti the upright in front of the rear central platform was placed against the front of the platform instead of on it, and this upright had an upright on each side of it. This trinity of uprights is carried as far east in the Tuamotus as Fakahina. Further east the feature begins to disappear, multiple rear platform uprights appear, and the marae takes on a remarkable resemblance to the Necker marae. (Illustrated with slides.)

IS THERE AN INDO-MALAYAN ELEMENT IN THE PTERIDOPHYTE FLORA OF SOUTHEASTERN POLYNESIA?

By

ELIZABETH D. W. BROWN

The 122 species of pteridophytes covered by the survey may be grouped according to distribution into (1) endemics or strictly Polynesian species, and (2) non-endemics having a range extending beyond Polynesia.

The endemics comprise not less than 66 per cent of the total number, a surprisingly large proportion considering the seeming adaptibility of fern spores for wind distribution. The probable center of origin of these species seems to be, in large part, the Tuamotuan region, whose flora in turn seems to have been derived, in large part, from the American continent.

The non-endemics comprise the remaining 34 per cent of the total number of species. Their origin may be considered from three lines of evidence as follows:

The closest affinities of each species shows that an overwhelmingly large proportion (80%) of the non-endemics find their closest relatives in the Indo-Malayan region, 6 per cent have their closest relatives in America, 8 per cent in Australia, and 6 per cent in Antarctica. Substantially the same percentages have been obtained for this region by other authors, some of whom have inferred that the flora of this region is largely Indo-Malayan.

It seems clear that although such statistics may point to a line of migration they do not indicate in which direction migration has taken place. It may have been eastward or westward.

A safer method of indicating the direction of migration of this group is to determine the probable center of origin of each species as indicated by the grouping of all of its relatives. By this method it is shown that an overwhelmingly large proportion (82%) of these non-endemics are probably of American origin, only 13 per cent are probably of Indo-Malayan or Asiatic origin, 2 per cent are probably of Australian origin, and 2 per cent probably of Antarctic origin.

Morphological characters of the spore and scale together with similar constant characters indicate that many species are older in the Marquesas and other parts of southeastern Polynesia than in Fiji or westward which strengthens the conclusions that migration has been from east to west rather than from west to east.

NOTES ON THE DICOTYLEDONS OF SOUTHEASTERN POLYNESIA

By

F. B. H. Brown

In part 3 of the manuscript of "The flora of southeastern Polynesia," now in the final stages of preparation, the dicotyledons to date described number 440 species and varieties as compared to 328 monocotyledons and 122 pteridophytes recently published in parts 1 and 2 respectively.

Time will not permit a full discussion of even a part of the 83 families represented in this part of the flora. Therefore some of the Campanulaceae have been selected because they are typical of a large part of the flora of this region in contributing evidence suggesting the former existence of high islands in the Tuamotuan region which seemingly served as a genetic center from which many Polynesian species have been derived.

To the genus *Sclerotheca* De Candolle of this family have been added two new species, one from Rapa and the other from the Marquesas. This necessitated the revision of the genus to include these new species with those from the Society Islands. As the genus is now revised, part or all of the anthers may be bearded at the tip, and the simple style may terminate in a slightly 2-lobed stigma or the style may terminate in two long stigmatic branches. However, the essential capsule characters remain fairly constant in all species. As De Candolle has stated: "The genus is well characterized by the sclerous capsule which is dehiscent by two pore-like openings at the apex." This character holds good for all of the species in southeastern Polynesia of which there are not less than five centering around the Tuamotuan region, two in the Society Islands, one in Rarotonga, one in Rapa, and one in the Marquesas, suggesting a Tuamotuan origin for the genus.

Another member of this family, a primitive lobelioid of interest, has been preserved in the Marquesas. To definitely place this, it has been necessary to erect a new genus *Cyrtandroidea.* This new genus closely connects the Lobelioideae with the Gesneriaceae through the Polynesian genus *Cyrtandra.*

LAND UTILIZATION IN THE HAWAIIAN ISLANDS IN 1930

By
JOHN WESLEY COULTER

Current literature draws attention to agricultural crises in various countries in the world. The question of the most profitable use of the land is uppermost. In Great Britain, South Africa, and Russia much attention is being given to this problem. Agricultural economists and economic geographers in the United States have attacked it. Last year Secretary of Agriculture Hyde called a conference on land utilization, the announced purpose of which was "to consider essential steps towards a nationalization policy of land utilization." In Hawaii, officers of the government, members of various departments in the University, and others are occupied with the problem.

The use of the land in the Hawaiian islands may be thought of in a general way in zones from sea level to about 7,000 feet. Taro and rice, sugar cane, pineapples, coffee, beef cattle, and forests are the products, respectively, from sea level upwards. Scattered areas at various elevations are used for dairy farming, diversified agriculture, and truck farming. By far the larger portion of the arable land is used for the production of sugar cane and pineapples. The cultivation of rice, formerly an important economic activity, has nearly ceased. Marginal pineapple land is being abandoned. A considerable amount of agricultural produce is being imported into Hawaii from the mainland of the United States each year. Preliminary surveys indicate that some of the imported commodities could successfully be produced in the Territory. The fact that much of the remaining arable land is in small, scattered holdings involves a problem in its cultivation, as large scale machinery cannot be used successfully. (Illustrated with maps.)

THE VITAMIN CONTENT OF CHINESE CABBAGE

By
MARJORIE G. ABEL and CAREY D. MILLER

Chinese cabbage (*Brassica chinensis*) is one of the most commonly used leafy vegetables grown in Hawaii. An investigation of its vitamin content, undertaken in the Nutrition Laboratory of the University of Hawaii, included determinations of the vitamin A, B, G and C potency of raw Chinese cabbage, and of the effect of salting and of pickling in salt-rice bran paste on that vitamin content. A short study of the vitamin B and G potency of rice bran was also made. The following conclusions may be drawn: 1, raw Chinese cabbage is an excellent source of vitamin A, in tests on white rats,

0.0416 gram daily inducing an average weekly gain of 6.4 grams per rat; 2, approximately half the vitamin A in the raw cabbage is destroyed in pickling in salt-rice bran paste; 3, raw cabbage is a fair source of vitamin B, 4.5 grams daily inducing an average weekly gain of 3.5 grams per rat; 4, rice bran compares very favorably with yeast as a source of vitamin B, 0.1 gram daily inducing a gain of 5.4 grams per week; 5, salting destroys a large part of the vitamin B, the feeding of a weight of salted cabbage equivalent to 4.5 grams of the raw food did not prevent a loss of 0.5 grams weekly; 6, cabbage pickled in salt-rice bran paste is an excellent source of vitamin B, 1 gram daily inducing an average weekly gain of 7.9 grams. Subsequent experiments by Miss Miller indicate that pickled cabbage has a vitamin B potency 8 to 10 times that of salted cabbage. This additional vitamin B was probably adsorbed from the rice bran. The mean pH value of the fresh leaf extract was 6.38, which changed during the pickling process to 4.74. This value is well within the range reported by other investigators as being most favorable to the adsorption of vitamin B on most adsorbing agents; 7, raw cabbage is a fair source of vitamin G, 5 grams daily inducing an average weekly gain of 7.06 grams, although all pellagra-like symptoms were not cured; 8, about a third of the vitamin G is destroyed in the pickling process; 9, rice bran is much lower in vitamin G potency than in vitamin B; 10, raw cabbage is a fair source of vitamin C, 3.0 grams daily preventing scurvy and inducing a fair growth in guinea-pigs; 11, pickling in salt-rice bran paste destroys approximately 85% of the vitamin C potency; 12, salting destroys more than 80% of the original vitamin C potency. (Illustrated with slides and charts.)

THE NUTRITIVE VALUE OF THE OPIHI

By
CAREY D. MILLER

The nutritive value of some of the principle vegetable foods of the ancient Hawaiians has been previously studied, and the work is now being extended to include the animal foods, the first being *opihi* (*Helcioniscus exaratus* and *H. argentatus*). *Opihi* were one of the most widely distributed and favorite shellfish of the ancient Hawaiians. They can usually be bought on the Honolulu markets today but are something of a luxury, as they sell for 25 to 30 cents a pound including shells. As only about 35 per cent is edible, the cost of this edible portion is approximately 80 cents a pound.

The only studies on the vitamin content of mollusks previously reported were made by Jones and Nelson of the Bureau of Chemistry in Washington

on oysters and clams. No studies have been made on the gastropods. Vitamin studies thus far completed indicate that whole *opihi* are devoid of vitamin C, that they have low vitamin B value and a fairly good content of vitamin G.

In view of the relatively low fat content (1.43%) of the *opihi,* it was not expected that they would show a high vitamin A and D content, but experiments have proven that they are a remarkable source of vitamin A and a good source of vitamin D.

Whole *opihi* contain an average of 77 per cent moisture, which means that 1 gram of fresh *opihi* is equivalent to 0.23 grams of dried material; 0.5 gram of fresh *opihi* per week gave, in rats, almost as good results as 0.1 gram of codliver oil, indicating that whole *opihi* are nearly as good a source of vitamin A as is a well-known brand of standardized codliver oil. This vitamin is concentrated partially, but not wholly in the organs of the shellfish. With a feeding of 0.05 gram weekly of fresh organs consisting of the hepato-pancreas and intestinal contents, the rats are protected from xerophthalmia and make good growth.

The eggs and sperm have been tested separately. The sperm are a better source of vitamin A than the eggs, even though the eggs contain more fat (8.71% as against 2.16%). Neither are such a good source of A as the organs, but are better than the whole *opihi.*

Four grams of *opihi* fed daily for 8 days to standard rats made rachitic by feeding the Steenbock diet for 21 days, gave full protection against rickets as judged by the line test. Two grams daily gave only fair protection. One gram of organs fed daily gave almost complete protection as did the eggs. In all cases tested, one gram of sperm daily gave complete protection. In contrast to these results, oysters and clams are reported as failing to give any healing when fed in 5 gram daily doses to rachitic rats for five days, and only slight healing in ten days.

Hawaiians state that the soft parts of the *opihi,* consisting of organs and gonads, were mixed with a little poi and fed to babies before they had teeth to chew the whole *opihi.* It would thus appear that the Hawaiians had in the *opihi* an excellent source of vitamins A and D that was consumed at all ages. (Illustrated with slides and charts.)

SCENES FROM THE LIFE OF EDISON

By
MABEL D. VERNON

Thomas Alva Edison can be called the benefactor of all humanity. His lifelong search for truth made him the greatest inventor of the age and gives him the highest rank for scientific creative instinct and insight. He

gave the world some 3,000 inventions which have revolutionized our everyday life. Whatever we do or wherever we turn we see the genius of Edison; his electric light, the telegraph system which he perfected, the telephone transmitter, the phonograph, the radio microphone, the motion-picture machine and the storage battery, all "miracles" of this great man's inspirations.

Edison's first experiment, at the age of twelve, was to test the theory that gases might enable a person to fly. He induced a boy employed in his father's family to swallow a large amount of Seidlitz powders. However, although the boy developed pains, he did not fly. His first patented invention was a vote recorder which, in spite of its value, was not popular with the legislatures, as it did not permit the members of these august bodies to change their votes after being recorded. His next venture was with stock tickers, and these proved popular and profitable.

Edison perfected the transmitter which made the Bell telephone a commercial success. After finishing with this he invented a machine that talked. This machine when perfected had required 65 patents and cost Edison over two million dollars. At the Paris Exposition in 1889 over 40,000 people flocked to hear the phonograph. The Eiffel Tower did not so completely astonish them.

Edison was not the first to search for an electric light, but he began where the others left off. Scientists challenged him to subdivide the electric current, as they declared it to be impossible. Edison left nothing untouched in his search for filament material, carbonizing everything he could lay his hands on. For some years a Japanese bamboo supplied the filament until superseded by the thread filament and then by tungsten.

Simultaneously with the achievement of the electric light, Edison made radical improvements in the construction of dynamos, making them suitable generators for systems of distribution of current for light, heat and power.

The two fundamental principles of modern radio belong to Edison, the microphone which he patented in 1887 and the "Edison Effect," on which every radio tube is based, invented in 1883. He filed his first patents on "wireless telegraphy" in 1885. A flood of inventors claiming the credit for wireless began to develop in the next decade, but Edison's position was assured. Attempts were made to secure his patents, but he took a firm stand in favor of Marconi, whom he considered the founder of radio.

Mention must be made of Edison's work with the storage battery. If this had been his only contribution to the world he would still be a great man. He made over 50,000 series of experiments, with 10,000 in each series. According to his own statement the storage battery called forth more original thought, work, perseverence and monumental patience than any other of his inventions. (Illustrated with slides.)

BIOLOGICAL RECORDS BY MEANS OF THE MOTION PICTURE CAMERA

By

RAY J. BAKER

The motion pictures shown related especially to life in the sea. The reels opened with shore scenes, to show the habitat, and then followed views of some of the familiar species of Hawaiian fish and a close-up view of an octopus, probably *Polypus marmoratus*. Several scenes were shown of the mottled periwinkle (*Littorina scabra*) in action. Of special interest was the detail picture of a holothurian (*Ophedesonia spectabilis*) which kept its shield-shaped tentacles in almost constant motion, and when irritated made use of the longitudinal muscles for contracting the body. A laboratory specimen of the mushroom coral (*Fungia scutaria*) was fed with crab meat. Small particles of the food were placed on the dorsal surface of the coral, and the process of gradually moving the particles of meat to the mouth and their engulfment was plainly shown. Special scientific interest lies in the fact that the film may be projected repeatedly, and the actions of the organisms studied until thoroughly analyzed. A micropicture was included which showed Brownian movement in minute particles of gamboge gum in water, and another showing the streaming of protoplasm in the leaves of Elodea. There were also views, taken with the interval camera, showing the sprouting of soy beans (*Glycine hispida*).

THE ROTATION AND DISTRIBUTION OF PLANTS

By

GEORGE C. MUNRO

A theory has been advanced that the indigenous plants of Hawaii have about run their course on the older islands. Flourishing in basalt in its early stages of decay, they deteriorate on the older soils.

The native plant life of Lanai bears out this theory in a marked degree. No native tree attains a large size there. Ohia and koa are small trees, and *mamani* is little more than a shrub. Some endemic species are almost extinct. Two plants which have evidently evolved to specific rank on Lanai are represented by only one known tree of each. On the other hand, exotic plants attain a maximum growth on the island. A Norfolk Island pine has reached a height of more than 100 feet and a diameter of 3 feet in fifty years. According to Wentworth, Lanai has had about 200,000 years of existence.

Mountain top bog plants transplanted from Puu Kukui on western Maui

are growing in the Lanai forest. Given conditions as near as possible to their native habitat, under a rainfall of about 250 inches less a year and at an elevation lower by 2,000 feet, a violet and a plantain have flowered, seeded, and given rise to young plants. The silver-sword and other plants are also growing well. This goes to show that competition has driven them to the open bog and higher elevation.

Perkins has drawn attention to the possibility that the lobelia family once predominated in the plant covering of these islands. The large number of endemic species and the evident modification of the beaks and tongues of some of the endemic honey-eating birds to enable them to secure the honey from the deep tubular flowers indicates the dominance of that class of flowers for a long time. Many of the endemic species of this family are suffering from competition with later arrivals.

THE LOCOMOTION OF GASTROPOD MOLLUSCS

By
D'ALTE A. WELCH

Most Gastropods move by either rhythmic or arhythmic locomotion. In rhythmic locomotion the animal is moved by rhythmic activity of the ventral surface of the body (the so-called foot), which appears in the form of dark color bands or waves. These bands are best seen through a plate of glass when the animal's foot is observed from below during progression. Animals showing arhythmic locomotion show no waves or bands on the sole of the foot. This form may be termed a refuge for our ignorance, for when we cannot explain how a certain species moves, we place it in the arhythmic group. It is probable that in time a great many snails said to have arhythmic locomotion will be found to have a definite type of rhythmic locomotion.

Gastropods having rhythmic locomotion fall into two groups, direct, where the waves move forward from the tail toward the head, and retrograde, where the waves move from the head toward the tail. In both these groups there are two types of waves, the monotaxic, where the foot is coursed by a single system of waves, and the ditaxic, where the foot is divided by a median line or furrow, the waves moving independently on each half. Where the waves start simultaneously on both halves of the foot and proceed with parallel motion we have opposite ditaxic locomotion. Where the waves move alternately on the two sides we have the alternate ditaxic type.

Besides these locomotor forms, there are still other methods. Thus the Cypraeidae progress by lateral waves, the Strombidae by a leaping movement, and the Truncatella by a curious stepping movement.

Each locomotor type has been found to be constant for all species of a given genus or family. If we look at any classification of the families of the molluscs, we find a hodgepodge of locomotor types grouped under the same suborder or section. Such a classification does not seem to give a true picture of the evolutionary development of the Gastropods. If, after more data have been accumulated, the molluscs are grouped according to their method of progression, we may not only formulate a far better arrangement of the Gastropod families, but we may obtain a clearer picture of the evolution of marine shells into land species. There is a chance that we may find intermediate forms enabling us to link up the entire evolutionary chain. (Illustrated with charts and motion pictures.)

THE INFLUENCE OF AGE, SEX, AND SITUATION ON THE FREQUENCY, FORM AND FUNCTION OF QUESTIONS ASKED BY PRESCHOOL CHILDREN

By

MADORAH E. SMITH

The material analyzed consists of verbatim records of the conversation of 153 girls and 152 boys ranging in age from 18 to 72 months, with the average at 43.6 months. Two situations were studied: A, when the child was alone with adults (198 records); and C, when he was engaged in free play with other children of preschool age (107 records). Of the 22,944 sentences recorded, 13 per cent were questions.

The most striking differences due to age were: 1, the increase in the proportion of questions to total number of sentences with each half-year up to five and one-half years, when both numbers and percentage fell, and the increase from 49 per cent of question-asking children at 2 years to 95 per cent at 5 years; 2, the same increase in proportion of questions to total number of sentences for mental ages from 2 to 5 years, with a drop at 6 years and a rise at 7 years; 3, "what" and "where" were the interrogative words most frequently used by the youngest children. "How," "when" and "why" were not used at all at two years, but after that increased in frequency at each age level, while the "what" and "where" questions correspondingly decreased in relative frequency; 4, almost half of the questions asked by two-year-olds were introduced by an interrogative word, about a quarter of them at 4 years and a third at 5 years; 5, questions of greatest frequency at two years, and which decreased in relative frequency with age, were those inquiring as to the whereabouts of persons or objects, and those asking for the names of persons or things; 6, questions increasing significantly with age were those of fact, time, invention, concerning number and calculation, concerning human intentions or actions, and those of cause.

The most striking differences due to sex were: 1, girls asked more questions at two years; 2, boys asked more causal questions and used "how" and "why" more frequently; 3, girls asked more questions concerning social rules, names of things and questions of place.

The most striking differences due to situation were: 1, many more questions proportionately were asked in A than in C, and there was a tendency, especially among the younger children in situation C, to direct many questions to adults; 2, questions concerning human actions or intentions and questions of fact, time, invention, cause, calculation and corroboration, barring mere requests for a repetition of the question and variations of the imperative, were more frequent in situation A; 3, questions of place, name, classification, and variations of the imperative were more frequent in situation C.

Those differences favoring boys and situation A are for the most part in the same direction as those noted in the older children. (Illustrated with charts.)

RACIAL "PASSING-OVER" IN HAWAII

By
ROMANZO ADAMS

A comparison of the census population of Hawaiians and part Hawaiians for 1930 with estimates based on the figures for 1920 and births, deaths, and removals for the intervening years indicates a passing over of six or seven hundred part Hawaiians into the Hawaiian group.

If one takes the reported births of Hawaiians and part Hawaiians for any recent year and deducts for each group the deaths reported up to 1930, the remainders—the numbers of those surviving—do not correspond to the census count in that the census has about twenty per cent more Hawaiians than expected and correspondingly fewer part Hawaiians. This suggests that when some part Hawaiians marry Hawaiians they consider the small amount of non-Hawaiian blood as too little to be worth reporting to the enumerator.

This theory is confirmed by some dark part Hawaiians who say that while they know that they possess a little non-Hawaiian blood, they do not think it enough to be worth reporting. They claim full Hawaiian ancestry.

This passing over of part Hawaiians does not appear to be induced by any hoped-for advantage. It seems to be just when the non-Hawaiian blood is not sufficient to be evident in their color or features or to affect their social status. Probably this passing-over has been going on for more than a hundred years and there is some ground for the conjecture that there was a higher proportion of such passing in the period 1830-1870 than in the more recent years.

Probably two-thirds of the present Hawaiians as enumerated for census purposes have at least a little of the blood of immigrants and transients who came to Hawaii after 1778.

A MEASURE OF ISSUES IN HAWAIIAN ELECTIONS

By
ANDREW W. LIND

The attempt to completely reduce politics to mathematical formulae is doomed to failure, but certain preliminary measures of election issues have been devised for Honolulu. The high ratios of participation in elections on the part of most of the racial groups bespeaks an informed and interested electorate.

The method utilized in the present study was the correlation of the vote received by various candidates in the elections of 1928 and 1930 in 46 precincts of Honolulu with certain other measurable factors, such as the ratios of the several racial groups, the percentages of the dominant economic group, and the proportion of party strength in the voting population of the same areas.

The disposition of all groups to vote for candidates of their own racial stocks appears prominently only with respect to candidates who are relatively unknown, or who represent no important civic issues. When a candidate becomes popularly identified with a given point of view or a vital public issue, he draws support from a variety of cultural and social levels, while at the same time he alienates a part of his own racial community. In the more hotly contested elections, the tendency for candidates to cut across racial lines is accentuated. Correlations between the votes received by various candidates of the same political party confirm local opinion that party affiliations exercise the greatest influence upon the vote, transcending all other bonds, such as race, religion, or economic class. The deviation of the vote polled by a given candidate from the pattern of his party suggests the best index of the effectiveness of "personal" factors in political campaigns. (Illustrated with charts.)

THE HOUSING PROBLEM AND ITS SOLUTION

By
HARALD WÜLFFING
(Translation by Dr. Robert E. Park)

In construction with public rather than with private funds there is the danger that the law of supply and demand will be left out of consideration, assuming that a building program of this sort is to be carried out and the

resources are to be divided accordingly under conditions prevailing in the present uneconomic procedure characteristic of large city development. With means provided by their taxpayers, large cities are able to build immense suburban cities. In doing this the officials assume that everyone who seeks a dwelling within the city is economically justified in settling there without taking into account the probable future demands of the community for labor. They accordingly undertake to assist, at public expense, in the erection of the necessary buildings without considering the possibility of the decentralization of industry and of the possible return of urban laborers to the rural type of living. The consequence is that a type of housing which has its origin in an economic situation that is uncontrolled is supposedly solved by the arbitrary intervention of governmental financing and in accordance with the uneconomic procedure imposed by the centralization of industries in great cities where the rent-barracks have been erected on the grandest scale.

The question of economic management, having in view the necessity of rebuilding, is solved by industry and commerce and by rationalization; in actual city building by decentralization of the industrially employed masses. Under these circumstances the question of high or low buildings, assuming the permanence of existing land values, will inevitably solve itself in favor of the low horizontal type, by a movement into the region of low-priced land.

New building, intended to meet the demand for housing, because of the high rate of interest and the lack of capital, must rely upon public rather than private funds, since public funds can be obtained at a lower rate of interest. The amount of the unsocial house-rent tax, funded for purely political purposes, is bound to be limited with the new building activity and, with the far-reaching intervention of private capital, in view of the greatest possible building activity, designed to diminish the numbers of the unemployed. However, this involves a complete and rapid abandonment of the public housing and of the official financial assistance for new building. The final consequence of all this will be the revival of reliance upon private credit and the return to a housing program which gives the widest scope to every sort of private initiative and permits the full and free functioning of the law of supply and demand.

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