PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

TENTH ANNUAL MEETING
1934-1935

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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."

The sessions of the Tenth Annual Meeting were held in Dean Hall, University of Hawaii, October 24 and 25, 1934, and May 16 and 17, 1935, ending with a banquet at the Pacific Club, May 18.

OFFICERS

1934-1935

President, Edwin H. Bryan, Jr
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PROGRAM OF THE TENTH ANNUAL MEETING

WEDNESDAY, OCTOBER 24, 1934, 7:30 P. M.

Mr. O. H. Swezey: Some highly concentrated populations of species of endemic insects.

Dr. Romanzo Adams: Myths and morale.

Dr. O. N. Allen, Mr. F. A. E. Abel and Dr. O. C. Magistad: Decomposition of pineapple trash by bacteria and fungi.

Dr. H. S. Palmer: Heights and ruggedness of the Hawaiian islands.

Mr. R. K. Tam, Dr. O. N. Allen and Dr. O. C. Magistad: The nitrogen fixing characteristics of Rhizobia. (Read by title.)

Mr. R. K. Tam, Dr. O. N. Allen and Dr. O. C. Magistad: The fermentative characteristics of Rhizobia. (Read by title.)

Dr. C. K. Wentworth: Types of marine benches on Oahu shores. (Read by title.)

THURSDAY, OCTOBER 25, 1934, 7:30 P. M.

Dr. C. K. Wentworth: Alaskan glacier studies.

THURSDAY, MAY 16, 1935, 7:30 P. M.

Preliminary announcements.

Election of members.

Appointment of committees.

Presentation of papers:

Dr. J. L. Collins and K. R. Kerns: Origin and significance of triploid and tetraploid hybrid pineapples.

Dr. C. K. Wentworth: The geologic structure of Nuuanu Valley.

Dr. J. W. Coulter: A gazetter of the Territory of Hawaii.

Dr. O. N. Allen and Dr. O. C. Magistad: A comparison of the *Aspergillus niger* and replaceable potash methods for the estimation of available soil potash.

FRIDAY, May 17, 1935, 7:30 P. M.

Dr. T. A. Jaggar: Shipboard plane-table and azimuth camera: an experiment in navigation.

Dr. M. E. Smith and J. Masuoka: Some factors influencing the language development of preschool bilingual children of Japanese ancestry in Honolulu.

Dr. H. A. Kirkpatrick: The red shift and the velocity of light.

Mr. C. S. Judd: Seed dispersal.

Dr. L. N. Bilger and Mr. E. Watanabe: A study of papaya carotene. (Read by abstract.)

Dr. C. P. Sideris and Miss B. H. Krauss: Oxidation-reduction systems of the pineapple plant. (Read by title.)

Mr. K. R. Kerns: The sequence of flower development in the pineapple. (Read by title.)

SATURDAY, MAY 18, 1935, 6:45 P. M.

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

ABSTRACTS OF PAPERS

HAWAIIAN BIRDS

(Presidential Address)

By
EDWIN H. BRYAN, JR.

About 100 species of birds were known to the Hawaiians, most of them by native names, prior to 1778. At that time, on Captain Cook's third voyage, specimens were collected of about 16 species, some of which were given popular descriptions by John Latham, and technical descriptions by Forster, Gmelin, and others. The types of many of these early species were lost, leading to much later confusion.

Collections by Andrew Bloxam, 1825, J. K. Townsend and Herr Deepe, 1836-7, and the United States Exploring Expedition, 1840, increased the known species to about 30, of which 16 were land birds including 14 perching birds. Sanford B. Dole listed 53 species in 1879. Dr. Leonhard Stejneger described specimens sent to the U. S. National Museum by Valdemar Knudsen of Kauai.

Encouraged by the enthusiasm of Professor Alfred Newton of Cambridge, Scott B. Wilson and Walter Rothschild became interested in Hawaiian birds. The extensive collections made by Wilson in 1887-8 resulted in the magnificent monograph, "Aves Hawaiienses", and in important anatomical studies by Dr. Hans Gadow, which indicated the true relationships of the Drepanididae. The 1,832 specimens obtained by Rothschild's collector, Henry Palmer, in 1890-3, furnished the basis for the even more elaborate "Avifauna of Laysan . . . ", published 1893-1900. R. C. L. Perkins collected for a decade, beginning 1892, and published a section of the "Fauna Hawaiiensis" on the birds, in 1903. Contributions have been made by W. A. Bryan, H. W. Henshaw, E. L. Caum, and others.

My check-list of Hawaiian birds numbers 218 species: 73 endemic or long indigenous, 18 sea birds, 11 regular migrants, 27 chance arrivals, and 89 exotic species. Of these last about 54 are probably established and 35 probably not established. More foreign birds are being brought in.

Sea birds include 2 albatrosses, the frigate, 3 boobies, 5 terns, various shearwaters and petrels, and red- and white-tailed tropic birds. For these, in 1909, was established the Hawaiian Islands Bird Reservation on islets to the northwest of Kauai.

The regular migrants include the golden plover, turnstone, wandering tatler, sanderling, curlew, various wild ducks, and other species. Most of these

do some little good by eating insects and scavenging the beaches, and should receive more protection.

The flightless rail and native hawk are probably extinct; the native duck and goose are becoming rare; the mudhens, stilt, owl and night heron seem to be holding their own in the lowlands.

All of the 50 to 55 species in the mountain forests are native perching birds. Of these, 23 of the 24 genera are also endemic, only Corvus being found elsewhere. These are all thought to have evolved from six or seven former immigrants, which arriving and becoming established over a long period of time have given rise, in the various environments, to the diverse forms of today. These include 6 species of thrushes, 3 flycatchers, 5 honeyeaters, and 35 to 40 native honey creepers or drepanids. The drepanids are thought to have developed from a common ancestor related to the Coerebidae of tropical America.

Many native species are becoming rare or extinct. A reason for this may be the sudden upsetting of the "balance in nature" by the coming of man with his cattle, sheep, goats, foreign plants and agriculture, which changed conditions in the native forest, and by the arrival of foreign birds with diseases against which the native species had no immunity.

Territorial laws protect native and useful birds and regulate the importation of exotic species. The introduction and liberation of additional species without adequate study by experts to determine their possible effect upon existing conditions is not advocated. (Illustrated with slides and specimens.)

SOME HIGHLY CONCENTRATED POPULATIONS OF SPECIES OF ENDEMIC INSECTS

By

OTTO H. SWEZEY

Although the list of species of Hawaiian endemic insects is long, yet the entomologist is usually disappointed by the scarcity of insect life in the native forests. Occasionally, however, even the rarest specimens or those not previously collected are discovered in quantities in the mountain forests. In my own experience some such discoveries concern the following species:

Nesotocus giffardi Perkins, Kaimuhonu, Oahu, November 17, 1918, on a recently fallen *Cheirodendron gaudichaudii; Nesotocus munroi* Perkins, Kohala Mountains, Hawaii, October, 1929, on a standing dead tree of *Cheirodendron gaudichaudii; Oodemus corticis* Perkins, Nauhi Gulch, Hawaii, October, 1931, on a standing dead trunk of *Acacia koa; Rhyncogonus saltus* Perkins, Kolekole Pass, Oahu, February 10, 1924, on the foliage of *Bidens sp.; Rhyncogonus simplex* Perkins, Makapuu, Oahu, February 11,

1934, on the foliage of *Gossypium tomentosum; Deinocossonus nesiotes* Perkins, Haleauau Valley, Oahu, December 1, 1929, on broken twigs of *Pteralyxia macrocarpa; Oegosoma reflexum* Karsch, Puu Oo trail, Hawaii, July 25, 1934, in rotten logs of *Acacia koa; Plagithmysus pulverulentus* (Motschulsky), Koolau Range, Oahu, on several occasions, in fallen trees of *Acacia koa; Plagithmysus varians* Sharp, Kilauea, Hawaii, July, 1934, in standing and fallen dead trees of *Acacia koa; Plagithmysus bilineatus* Sharp, Kilauea, Hawaii, July, 1934, in recently cut logs of *Metrosideros polymorpha; Plagithmysus blackburni* (Sharp), Nauhi Gulch, Hawaii, October 3, 1931, in a recently dead tree of *Sophora chrysophylla; Plagithmysus molokaiensis* Perkins, Kamiloloa, Molokai, December 20, 1925, in dead trees of *Pipturus albidus; Nesithmysus bridwelli* Perkins and *Nesithmysus haasii* Perkins, near Puu Kaaumakua, Oahu, February 9, 1931, in *Pelea clusiaefolia; Callithmysus microgaster* (Sharp), Waikane, Oahu, January 19, 1930, in a dying tree of *Bobea elatior; Proterhinus subplanatus* Perkins and *Xyletobius timberlakei* Perkins, Marsh trail, Oahu, December 10, 1933, in a dead trunk of *Straussia mariniana; Scotorythia paludicola* (Bulter), Olinda, Maui, January, 1926, on the foliage of *Acacia koa; Hyposmocoma latiflua* Meyrick, Waianae Range, Oahu, December 29, 1929, on the leaves of *Pittosporum cauliflorum.*

(Illustrated with lantern slides.)

THE DECOMPOSITION OF PINEAPPLE TRASH BY BACTERIA AND FUNGI

By

O. N. Allen, F. A. E. Abel and O. C. Magistad
(Tropical Agriculture, Vol. 11, pp. 285-292, 1934.)

The decomposition processes of entire pineapple stumps and of coarsely and finely cut stumps and leaves were analyzed by chemical and microbiological methods. The greatest difference between the decomposed and the original plant material was accounted for by the decomposition of sugar, starches, and cellulose. Other chemical changes in the pineapple material were slight. The nitrate nitrogen content of the soil was increased and much carbon dioxide was evolved. The numbers of fungi, actinomyces, and bacteria were increased. (Illustrated with charts.)

HEIGHTS AND RUGGEDNESS OF THE HAWAIIAN ISLANDS

By

HAROLD S. PALMER

(University of Hawaii, Occ. Papers, No. 23, 1935.)

A comparison of the ruggedness of regions may be based on a comparison of maximum heights or range in elevation. On these two counts the Hawaiian islands are exceeded in ruggedness by several states. But using the ratio of the number of feet in the range to the number of thousands of square miles in the area of each unit, or comparing the number of feet in the elevation of the range to the number of miles in the side of a square having the same area, the ruggedness of all eight of the Hawaiian islands is proved to be greater than that of any state. (Illustrated with charts.)

THE FERMENTATIVE CHARACTERISTICS OF RHIZOBIA

By

R. K. TAM, O. N. ALLEN AND O. C. MAGISTAD

Four strains of Rhizobia (nodule-forming bacteria) isolated from nodules on the roots of *Vigna sinensis* Enderlein, four strains from nodules of *Crotalaria juncea* Linnaeus, and eight strains from nodules of *Cajanus cajan* (Linnaeus) Millspaugh were studied culturally in three basic liquid media, a, without a source of nitrogen, b, with yeast extract as an organic source of nitrogen, and c, with potassium nitrate as an inorganic source of nitrogen. Fifteen carbohydrates were used as carbon sources in combination with the above media.

The best growth attained by each strain, as evidenced by turbidity tests and changes in hydrogen-ion concentration, occurred in the media with the organic nitrogen source. In like manner the growth in the inorganic nitrogen media exceeded that in the nitrogen-free media. These data resulted regardless of the source of carbon.

The hexose sugars afforded the best source of carbon for the growth of Rhizobia. Of the four hexose sugars studied, glucose, galactose and mannite were more readily utilized than was fructose. Following the hexoses the other carbohydrates were utilized in the following descending order regardless of the nitrogen source: disaccharides (sucrose, lactose, maltose), trisaccharides (raffinose, melezitose), pentoses (rhamnose, arabinose, xylose), polysaccharides (starch, dextrin), and a glucoside (salacin). All strains of the Rhizobia produced alkaline reactions in litmus milk without the formation of serum zones.

THE NITROGEN-FIXING CHARACTERISTICS OF RHIZOBIA

By

R. K. Tam, O. N. Allen and O. C. Magistad

Cross-inoculation experiments have been completed using Rhizobia (nodule-forming bacteria) isolated from *Cajanus cajan* (Linnaeus) Millspaugh, *Vigna sinensis* Enderlein and *Crotalaria juncea* Linnaeus as inocula for the seeds of these plants. Nodules were formed on the roots of all of these test plants regardless of the host inoculation, thus confirming the classification of these plant species within the cowpea cross-inoculation group.

The strains of Rhizobia varied greatly in their abilities to fix atmospheric nitrogen and to promote plant growth. The range in percent nitrogen fixed in plants of *Crotalaria juncea* varied from 0.72 percent to 2.22 percent, in *Vigna sinensis* from 1.71 percent to 2.68 percent, and in *Cajanus cajan* from 1.36 percent to 2.17 percent. The amounts of fixed nitrogen were determined by the Gunning-Kjeldahl method modified to include nitrates. The percentages of nitrogen are expressed on a dry weight basis.

All strains of the Rhizobia studied, irrespective of their host isolation, inoculated *Vigna sinensis* with greater ease than they did *Crotalaria juncea* and *Cajanus cajan.*

TYPES OF MARINE BENCHES ON OAHU SHORES

By

Chester K. Wentworth

Interpretation of emerged marine benches is dependent on knowledge of bench-forming processes and the relation to sea level in which they are being concurrently formed. Studies in progress reveal the following types. 1. Bench surfaces made level by water-level weathering. Elevations are variable, are within the spray catchment zone, and determined fundamentally by other processes. 2. Organic veneer benches formed at 0 to 3 or 4 feet above mean sea-level as determined by level of overwash sufficient to support marine forms. Found on calcareous rock costs where higher benches have been reduced by solution-pitting to apparent level of sea-water saturation and then invaded by mechanical wave action at the veneer bench level. 3. Beach pediments rising inland to several feet above sea level and conforming to the equilibrium curve or adjacent or partially coextensive beaches of sand or gravel. Due to mechanical action under control of the beach profile. The level of water-cut nips is likewise controlled by the beach curve rising to several feet above tide at the heads of gravelly pocket beaches. 4. Benches

of earlier origin in process of concurrent reduction by potholing, where moderate amounts of coarse debris are available. 5. Benches produced by strong wave-quarrying as influenced by rock structure. Tend to be steep-sloped and to rise to a broadly rounded nip well above sea level.

Other locally distinctive types will probably appear on further study. Each of the above occurs in pure form and also somewhat merged with or partially destroyed by the invasion of other processes. Nature of coastal exposure, type of rock, amount of debris, stream source of land-derived debris, are among the factors fixing the local combination.

THE ORIGIN AND SIGNIFICANCE OF TRIPLOID AND TETRAPLOID PINEAPPLES

By

J. L. Collins and K. R. Kerns

The diploid number of chromosomes for the pineapple is 50. Plants containing 75 (triploid) and 100 (tetraploid) chromosomes have appeared in hybrid cultures.

The triploids are believed to originate from the formation of diploid egg cell gametes containing 50 chromosomes which are fertilized by the normal 25 chromosome pollen grains. The ratio of triploid to diploid plants in the Cayenne $\times$ Wild Brazil F_1 hybrid population indicates that Cayenne produces one diploid egg gamete per 1,000 haploid egg gametes. The 13 different clons of triploid plants are divided according to chromosome content as follows: eight clons, each derived from a single triploid plant having 50 Cayenne and 25 Wild Brazil chromosomes; two clons have 50 Cayenne and 25 Monte Lirio chromosomes; one clon has 50 Cayenne and 25 Pernambuco chromosomes; one clon has approximately 62 Cayenne and 13 Ruby chromosomes; one clon has approximately 62 Cayenne and 13 Wild Brazil chromosomes. The triploid plants and their various parts are larger than the diploids. The cells of the triploids have the volume increased by 40 percent.

Fruit size shows variation depending upon the size of the fruits of the parental types; the fruits of triploids having 25 chromosomes from Wild Brazil being smaller than diploid Cayenne fruits but larger than the fruits of diploid hybrids between these varieties. Two triploids produced fruits with an average weight of two pounds greater than Cayenne.

Of the 10 clons of tetraploid plants, 9 represent the complete progeny obtained by pollinating Cayenne flowers with pollen from the triploid which had approximately 62 Cayenne and 13 Ruby chromosomes. Each of these

tetraploids are probably genetically different, but all contain approximately 82 Cayenne and 13 Ruby chromosomes, since they appear to have originated from the fertilization of normal 25 chromosome egg gametes from Cayenne with 75 chromosome pollen grains from the triploid male parent. One tetraploid clon originated from a single plant in the F_1 Pernambuco $\times$ Monte Lirio population and apparently contains 50 chromosomes or the complete diploid number from each variety.

The increase in plant size and in size of cells and parts of the plant is carried still further in the tetraploid plants than in the triploids.. The volume of the tetraploid cells is 60 percent greater than that of the diploid cells. Triploid pineapples are sterile to a very high degree; only a few among very many pollinations have resulted in seed formation. The tetraploids on the other hand appear to be as fertile as the diploid form. By crossing tetraploid and diploid forms, sterile, seedless, triploid forms should be produced in large quantities. This promises to supply a new method of plant breeding which has never before been used purposely.

Polyploidy confers some characteristics not possible in diploid forms. Three of these are: 1—greater tolerance to environmental conditions, permitting a wider geographical range; 2—a greater genetic stability and less frequent appearance of off-type mutations; 3—a greater degree of expression or development of those characters dependent upon the cumulative action of multiple genes than is possible in the diploid form. (Illustrated with charts and lantern slides.)

GEOLOGIC STRUCTURE OF NUUANU VALLEY

By

CHESTER K. WENTWORTH

Nuuanu Valley is one of more than thirty valleys by which the leeward slope of the Koolau Range of Oahu is dissected. This dissection discloses a remarkable general unifomity of thickness and slope of the thin basalt flows of which the leeward portion of the mass is composed. Nuuanu Valley differs from many of the valleys in its nearly uniform bottom gradient from Honolulu to the Pali gap and in its flat or slightly convex transverse bottom profile. This configuration is due to the filling of a once much deeper valley by several thick lava flows of a new series, which came from two vents now marked by cinder cones, and located 1.2 and 1.8 miles seaward from the head of the valley. The new lava is markedly different petrographically from the basalt of the main range.

Diamond drilling, carried to over 400 feet in five holes, and to lesser depths in ten others, reveals a basalt fill of the valley in excess of 300 feet, overlying an impermeable floor of weathered alluvium more than 100 feet thick. Near one of the source vents, nearly 300 feet of cinder tuff was penetrated, revealing additional details of structure. From this drilling and older artesian well borings nearer the coast it is now known that Nuuanu Valley was once eroded 400 to 800 feet below its present bottom at a time when sea level was upward of 1,000 feet below its present position. In addition to the lava flows revealed by drilling there were apparently large alluvial contributions to the fill, increasing toward the coast, and forming along the coast the cap rock which restrains the artesian water under Honolulu. (Illustrated by maps and demonstrational material.)

A GAZETTEER OF THE TERRITORY OF HAWAII

By

JOHN WESLEY COULTER

(University of Hawaii, Research Pub., No. 11, 1935.)

The gazetteer is compiled from available maps and contains an index to place names located by latitude and longitude. (Illustrated with maps.)

A COMPARISON OF THE *ASPERGILLUS NIGER* AND REPLACEABLE POTASH METHODS FOR THE ESTIMATION OF AVAILABLE SOIL POTASH

By

O. N. ALLEN AND O. C. MAGISTAD

The present study has involved the comparison of results of a strictly chemical method with those of a biological method for the estimation of soil potash available to plants. The replaceable potash method is based upon the principle that the potassium is released from the soil by ammonium acetate, is precipitated as potassium cobaltinitrite, and estimated by titration with standard potassium permanganate. With the *Aspergillus niger* method the amount of available potash in a soil is determined by the weights of the fungal mycelium when the mold *Aspergillus niger* is grown in a nutrient solution under specified conditions. Throughout these tests the Niklas strain of the mold was used.

Eighty-three pineapple soils have been tested by these two methods. These soils, taken from potash field experiments, have ranged from a low limit of 50 pounds of available potash to a high limit of 2,600 pounds per acre foot

of soil, based on 2,400,000 pounds of soil per acre foot. In the majority of tests conducted to date there has been shown mathematically to be a high degree of correlation between the results of the two methods. Acceptable agreement has also been obtained between the results from these methods and yield responses from actual field tests with pineapples. However, as a general rule the *Aspergillus niger* method has given a slightly larger potash content in the soil than has the chemical method, a fact possibly due to the greater solution and absorption by the mold of the less readily available soil potash in the citric acid medium. Work is in progress to determine mathematically an equation which will make possible the conversion of the results of one method into the other within an accepted degree of accuracy. (Illustrated with charts and demonstrational material.)

SHIPBOARD PLANE-TABLE AND AZIMUTH CAMERA: AN EXPERIMENT IN NAVIGATION

By

THOMAS A. JAGGAR

The zenith star locates a place in latitude and longitude, if accurate time is read at the instant of observation. The zenith point on a star map may be found by three-pointing other stars, by the method of the topographer. A timed observation, by eye, of the zenith point among the stars may locate a practised observer within 30 nautical miles. All navigation schools should train students to recognize declination belts and meridian belts among the stars. A student so trained, flying an airplane, could tell, by merely looking up at night, the half-degree belts of latitude between 19 degrees and 22 degrees North, from the south end of Hawaii island to the middle of Kauai island.

The experiment with an F. 1.9 camera directed to the zenith, one minute exposure, super-sensitive film, photographed numerous stars, each 1 mm long on a 3¼ × 4¼ inch film. One minute of time is 15 miles of longitude. For finding the zenith point among the stars, the camera was rotated in azimuth 180 degrees, and exposed for a second time on the same stars, the epoch of the observation being the instant of rotation between the two exposures. Joining identical stars across the print for this instant with ruled lines, the intersection point was the zenith. This was matched to a star map for that instant of sidereal time Greenwich. The declination is the latitude. The difference of the right ascension, from Greenwich, is the longitude.

At sea the essentials of the method are: 1, a basic azimuth for the time of observation; 2, simultaneous azimuth for three or more stars; 3, corrected

Greenwich time reading for the epoch; and 4, a strictly equiangular or photographic star projection map, wherein azimuth lines are of first importance. Possibly the stereoscopic projection is the best.

A shipboard plane-table was exhibited as a first experimental attempt to use a mirror, and rule star azimuths with a hard pencil. The instrument is a rebuilt theodolite hung in gimbals. The telescope, converted to a sighting tube, is hung with a mercury cup floating a star mirror, and straight edges mark the star azimuths on a ring card. The ring card, with stretched silk threads on the azimuths, is set over the star map. A voyage to Kauai was used for tests. The gimbals hold the star image in the sights in a seaway, and a compass card checks the steersman's holding of the base azimuth. Preliminary trials gave errors of from 6 to 15 miles, and tests of technique are in progress. These involve reversals and repetitions for averaging out error, improvements in lighting, sighting and clamping for securing simultaneous record, and calibration of the mirror leveling, for holding the zenith. It is believed that a simpler instrument will result, accurate within about 10 miles on an airplane and possibly 5 miles on a steamship. Incidentally the star map gives local time and total compass correction directly. (Illustrated with instruments and charts.)

SOME FACTORS INFLUENCING THE DEVELOPMENT OF LANGUAGE IN PRESCHOOL BILINGUAL CHILDREN OF JAPANESE ANCESTRY IN HONOLULU

By

MADORAH E. SMITH AND JITSUICHI MASUOKA

Fifty sentence samples of the conversation of 125 bilingual children of Japanese ancestry living in Honolulu and ranging from 18 to 78 months of age, were recorded verbatim by bilingual university students and compared with similar conversations of 200 monoglot American children.

The bilingual children were found to be behind the monoglot on all measures used, especially after three years of age. They used shorter sentences, fewer compound and complex sentences, fewer connectives, and asked fewer questions pertaining to the causes and reasons of things, but asked more questions requiring the repetition of remarks made to them. In all of these measures the backwardness was not due to the faulty English most of them heard. This corrupt English showed its influence by an even greater discrepancy between their performance and that of the monoglots in those measures which considered performance in English only. Thus the bilingual children used fewer articles, conjugated verbs less often, made many more

errors per hundred English words spoken, and used a larger proportion of interjections, much more frequently a part of infant than of adult speech. Their use of Japanese was also very incorrect.

The amount of English used increased with age after four years. At the lower ages, about 40 percent of the sentences and a little more of the words used were English. Between 20 and 30 percent of the sentences recorded at all ages, included words from more than one language.

Factors influencing the amount of English used and the correctness of speech were sex (boys using more English than girls), residence (children living among other racial groups using more English), and especially the amount and quality of English used in the home. It was also found that later-born children used more English than did the eldest and second children of the family. (Illustrated with charts.)

THE RED SHIFT AND THE VELOCITY OF LIGHT

By
HARRY A. KIRKPATRICK

In the study of the spectra of stars and nebulae, spectral lines are commonly found to be shifted from their normal positions toward either the red or the violet end of the spectrum. This is interpreted as a Doppler shift due to motion of recession or approach. Hubble and Humason with the Mount Wilson 100-inch telescope have photographed spectra of more than eighty nebulae at distances from one million to 150 million light years. In 1929 they announced that all distant nebulae are receding with velocities directly proportional to their distances from us, and that the rate of recession is about 550 km/sec/megaparsec. This indicates that the universe is doubling its diameter every 1,300 million years, which involves velocities greater than the physicist's limiting velocity, that of light.

Various other explanations have been offered to avoid this, including Zwicky's "gravitational drag" to account for the loss of energy by the photon and the consequent increase in wave-length, since Energy = hc/wave-length, where h and c are constants. Wold has recently proposed that the velocity of light has been decreasing during the passage between the nebula and the observer, which would account for the red shift.

It is shown that a small acceleration of approximately 20 cm/sec/yr in the velocity of light will account for the red shift without any change in the energy of the photon, and that it is theoretically possible to make certain experimental tests of this theory. Practically it would be difficult to gather enough light to perform the experiments. No other theories seem subject to direct test. (Illustrated with slides and charts.)

SEED DISPERSAL

By

CHARLES S. JUDD

Plants with the best means of seed dispersal are the ones which have wandered farthest and invaded new territory most successfully. Methods and results of seed dispersal in Hawaii by wind, water, birds, animals, man, gravity, and the "step-ladder method" or slow inland migration from the sea, are discussed.

(This paper is listed for publication in the Mid-Pacific Magazine.)

A STUDY OF PAPAYA CAROTENE

By

LEONORA N. BILGER AND ERNEST WATANABE

Carotene is the plant pigment which has been established as the precursor of the vitamin A of animal tissues. The vitamin A activity of papaya, fed to rats, has been found by Miss Carey Miller to be relatively high. One gram of papaya is equivalent to 40 gamma of carotene.

The authors found carotene very difficult of isolation from papaya by the methods that result in high yields of beautifully crystalline carotene from carrots. Colorimetric determinations showed one gram of papaya to contain 0.015 milligrams of carotene, the equivalent of 15 gamma of vitamin A activity. The presence of xanthophylls was noted during the preparation of papaya carotene.

From 1931 to 1934, a number of authors have attributed vitamin A activity to chlorophyll and xanthophylls. If further experimentation establishes the vitamin A activity of xanthophylls, it is probable that the high vitamin A activity found in the nutrition laboratory for papaya is consistent with the low carotene content determined colorimetrically in this study. Whole papaya may owe its vitamin A activity to three or more substances including chlorophyll, xanthophyll and carotene.

OXIDATION-REDUCTION SYSTEMS OF THE PINEAPPLE PLANT

By

C. P. Sideris and B. H. Krauss

The different tissues of the leaves of pineapple plants possess different degrees of oxidation-reduction properties. The terminal tissues reduce methylene blue and indigo-tetrasulphonate at a very great rate, whereas the basal ones reduce it very slowly, or not at all. The experimental procedure is as follows.

The sap of the tissue under investigation is neutralized and well buffered to pH 7.0 to minimize the possible effect of hydrogen ions before the dye is subjected to the influence of the extracted sap. The sap and the dye are mixed and placed in an incubator and examined at different intervals for discoloration of the dye. The rate of discoloration of the dye indicates the reducing efficiency of the sap. Oxidation-reduction potentials may also be determined by means of a potentiometer using a bright platinum electrode in an oxygen-free atmosphere. The reduction of 5 cc of tetrasulphonate (100 mg per liter) by one cc of sap from the different tissues of the longest leaves of the pineapple plant during a period of 24 hours was as follows: Basal, 0 percent; intermediate basal, 0 percent; intermediate medial, 10 percent; intermediate apical, 95 percent; terminal, 100 percent. The chemical properties of the reductant are similar to those of ascorbic acid or vitamin C.

THE SEQUENCE OF FLOWER DEVELOPMENT IN THE PINEAPPLE

By

Kenneth R. Kerns

The meristematic area of the pineapple leaf is small in relation to the diameter of the stump at the apex of which it is centrally located. The first visible evidence of leaf development is a bulge or small ridge composed of a number of cells at one edge of the circular growing point. After the primordium of one leaf has grown for a time the next leaf primordium becomes evident on the opposite side of the growing point. The time interval between the origination of successive leaves is apparently uniform, as is the circular distance around the growing point between successive leaf points of origin. This is shown in the size relations between the young growing leaves.

In order to create a greater number of new growing points beyond those afforded by an apical meristem originating leaves, it is necessary for the

meristematic area to widen. This widening of the growing point is the first evidence of the transition of the growing point from the purely foliar meristem to a fruit bud meristem. Averages of 25 plants dissected weekly indicated that this change occurs 38 days previous to any evidence of redness in the heart of the plant, which is the first field evidence of flowering.

After the increase in diameter of the apical meristem, leaf-like primordia appear around its margins. These become the bracts, subtending the individual flowers. Directly above each of the bract primordia appears a convex area of thin walled meristematic cells. At equidistant points on this convex area there appear small protruding masses of cells, not unlike leaf primordia, which produce the sepals. Inside these sepal primordia there occur successively the primorida of the petals, stamens and carpels.

The flower parts originate in sets of three. The members of each set grow simultaneously and the different sets in succession. The sepals and petals grow upward at an acute angle with the base and form a double closed tent over the essential flower organs. The six stamens start also as leaflike primordia. The pistil with its three carpels originates in a similar manner within the circle of stamens.

All the floral parts originate at the same level and grow away from this point of origin. The central portion of the growing point, around which the floral parts originate, does not share in this growth but remains at the original level. The growth of the parts around this area thus produces a cup or cavity. The growth rate of the different whorls of the flower appears to be different, the outer ones growing faster, causing the walls of the cavity to grow together at the top. The growth and development of the carpels then fills up this cavity, becoming folded in a characteristic fashion. The apex of each carpel grows upward between the stamens and there fusing into a single unit becomes the style and stigma of the pistil.

The edges of the carpel primordia not only come together during growth but are forced to curl back upon themselves, causing the edges to be turned in opposite directions. When growth and development of the carpels is completed this twin nature of the placental area is not evident, unless the fusing is incomplete at some point, causing intercarpellary fissures. Defective spots in the mature fruit are often caused by such fissures.

NECROLOGY

Yakichi Kutsunai, a charter member of the Hawaiian Academy of Science, was born in Japan on January 10, 1883, and died in Honolulu on December 27, 1934. The son of an immigrant plantation laborer, Mr. Kutsunai was a graduate of the University of Hawaii in agriculture, cum laude, a member of several local scientific societies, and had been connected with the Experiment Station of the Hawaiian Sugar Planters' Association for 22 years, holding the position of Associate Agriculturist at the time of his death. Mr. Kutsunai was a keen mathematician. His work in the mathematical evaluation of statistical data was outstanding. He also made valuable contributions to sugar cane breeding and culture. Surviving are the widow and five children.

Burt Adams Tower.....1878-1927
Frederick Charles Newcombe.....1858-1927
Edgar Wood 1861-1928
Walter Le Montais Giffard.....1856-1929
Benjamin Davis Bond.....1853-1930
Albert Burkland 1873-1930
Lorrin Andrews Thurston.....1858-1931
Stuart Gardner Wilder.....1890-1931

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Hutchinson, A. E.

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Ito, Kiyoshi

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Johnson, Roswell H.
Jones, Austin E.
Jones, Martha
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Judd, Charles S.

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Krauss, Frederick G.

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Wilder, Helenor C.
Willard, Harold F.
Williams, Francis X.
Williams, John N. S.
Wilsie, C. P.
Withington, Mrs. Arthur
Withington, Paul

Yang, You Chan
Young, H. Y.

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Wülffing, Harald, Berlin-Zehlendorf, Germany