THE COLLECTING NET

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THE SIXTH INTERNATIONAL CONGRESS OF GENETICS AT ITHACA

Dr. C. C. Little
Chairman of Executive Council and Secretary-General of the Congress

The Sixth International Congress of Genetics, occurring at Ithaca from August 24 to 31, has had an interesting and unique history of development. As in the case of almost all international bodies, the organization which continues between one meeting and the next is, in the case of genetics, somewhat attenuated and scattered. This cannot be avoided if many countries are to be represented. The adinterim committee, which was charged with establishing an Executive Council to organize and administer the Congress, met and appointed a Council consisting of eight members. These represented the chairmen of committees of finance, transportation, program, exhibits, publications, and local arrangements, the Treasurer of the Congress, and the Secretary-General as Chairman. The meetings of the Council began on December 28, 1929. Since that time the Council has met frequently and has devoted a (*Continued on Page* 5)

VOYAGES OF THE "ATLANTIS" AND ITS OCEANOGRAPHIC WORK

Columbus O. Iselin, 2nd,
Captain of the Atlantis

A year ago the officers and scientists of the crew of the *Atlantis* were just beginning to gather in Copenhagen. We employed our time during May and June in supervising the completion of the vessel and in getting together our scientific apparatus. On July 7th we set sail for Plymouth, England. Since then the boat has been at sea almost continuously except during the months of September, January and May. Therefore, I can report the result of about 7 months' work at sea and through a review of this beginning you can form a good estimate of what can be expected in the future from the Woods Hole Oceanographic Institution.

Since I have been aboard the *Atlantis* a good part of the time during the past year, I can discuss this phase of the Institution's work with more authority than I can the work in the laboratory at Woods Hole. It seems suitable to stress our experiences at sea with the *Atlantis* because it is a new and exciting event to

M. B. L. Calendar

FRIDAY, JULY 1, 8:00 P. M.

Lecture: Dr. Paul S. Galtsoff, Biologist United States Bureau of Fisheries, Washington, D. C.

"The Coral Reefs of the Hawaiian Islands."

(Illustrated with lantern slides and underwater motion pictures.)

SATURDAY, JULY 2, 8:00 P. M.

M. B. L. Mixer: at the M. B. L. Club House. Scientific workers, their families and guests are cordially urged to attend.

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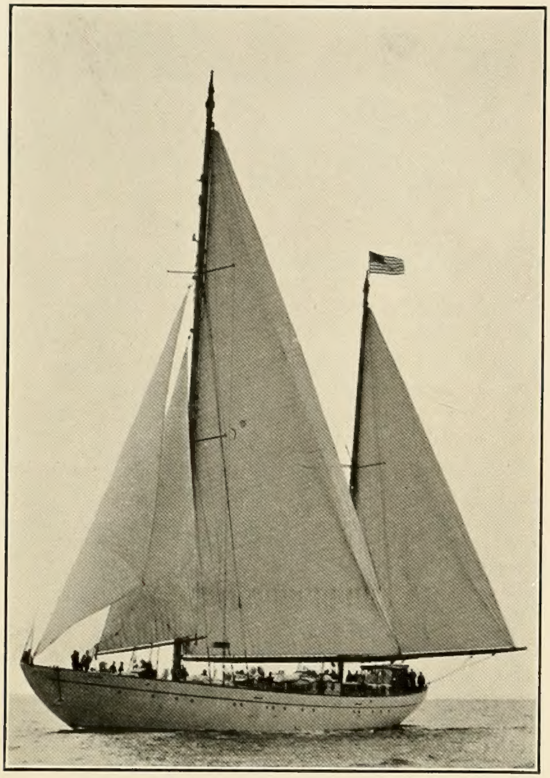


THE "ATLANTIS"

be able to report that at last an American scientific ship has been commissioned for continuous oceanographic investigations.

In The Collecting Net last summer I gave you a general description of the *Atlantis*, but a few more words of explanation may be of interest. She is a diesel auxiliary ketch of about 420 tons displacement and 142 feet in extreme length. Her sail area consists of about 7200 square feet of canvas and her main engine, developing some 280 horse power, can easily maintain a cruising speed of 8 knots. Below decks her accommodations include cabins aft for a scientific staff of five and amidships a large laboratory which is at present mainly used for chemical work. On deck and also amidships is another laboratory where the biologists can examine and preserve the townet catches and where the samples are collected from the water bottles and the thermometers read.

The main trawl winch, carrying 10,000 metres of ½" diameter cable, is located in the lower hold but can be controlled from the deck. The hydrographic winch stands on deck just aft of the laboratory. Both winches are electrical and fitted with automatic devices for guiding the wire on the drums. Our cruises to date have proved that in every way the gear is well designed and entirely suitable for the work. We have not regretted the fact that the *Atlantis* is a sailing vessel and not a full power type. The sails have proved their worth under stormy conditions, for weather has yet to be experienced so severe that a station could not be made. Under moderate conditions, especially in the tropics, the absence of engine room heat and lack of noise and vibration are more obvious recommendations for this type of vessel. The fuel and water supply is ample for cruises up to two months in length, but by being careful with the water, we could remain out much longer if necessary.

The first cruise, which was also the trial trip, began on July 16th at Plymouth. The initial objective was a line of stations following longitude 30° W and extending far enough north and south to cross the major branches of the easterly moving currents in the north Atlantic. The accompanying diagram shows the approximate location of this section, as well as the other sections we have run to date. These sections consist of about 250 stations. In the deep water, the majority of them extend down to 3000 metres, but at about every fifth station, observations have been secured to the bottom. Since the stations have seldom been more than 100 miles apart, and usually much closer, they give a very complete picture and should go far to help in the understanding of the circulation of the North Atlantic. Although temperature and salinity observations have been a routine part of all our cruises to date, they by no means represent all that has been accomplished. Therefore, keeping this in mind, we will describe our cruises from the point of view of the special investigations undertaken along with the hydrographic work.

On the first cruise, Dr. Franz Zorell of the Deutsche Seewarte, carried out oxygen determinations of all the water samples collected. Dr. George Clarke was in charge of a special investigation of the penetration of light below the sea surface. The Institution had secured a photoelectric apparatus, built under the direction of Dr. Atkins at the Plymouth Laboratory, who has, of course, carried out extensive investigations of the influence of sunlight on the diurnal migration of the plankton in the English Channel. The *Atlantis*, therefore, was merely continuing this work out into deeper water, but since the light there penetrates so much deeper, the work was considerably complicated. Of special interest, are the plankton tows made in connection with the photometric observations. Five simultaneous tows were made with closing nets in such a way that the exact depth of each net was known, and these tows could be repeated at suitable intervals throughout the day so that an accurate picture was secured of the influence of light on the movements of the plankton.

On this cruise also the *Atlantis* made a number of eel tows for Prof. Johannes Schmidt. Using the same technique as has been developed on board the *Dana*, catches were made each evening mainly in regions where Prof. Schmidt had too few observations. These eel nets are two metres in diameter at the mouth and were sent down four at a time fastened at intervals to our heavy trawl wire. In order to test out the main winch for deeper tows, a number of hauls were also made for deep sea fish with good result.

After the *Atlantis* had reached Woods Hole, it was found necessary to make a few minor changes in the balasting and rigging, so it was not until early in October that she was ready for sea again. Her next cruise was southward along the continental shelf to Cape Hatteras. This series of sections was planned to supplement the report on the coastal waters from Cape Cod to Cape Hatteras which Dr. Bigelow is now at work on, and which will be similar to his investigation of the Gulf of Maine. The greater part of his observations have been made by the U. S. Bureau of Fisheries steamer *Albatross*, but he had no survey after October. The *Atlantis* completed 43 hydrographic stations in about 8 days, as well as a general plankton survey of the region. Mr. H. R. Seiwell carried out pH and phosphate determinations of all the water samples collected.

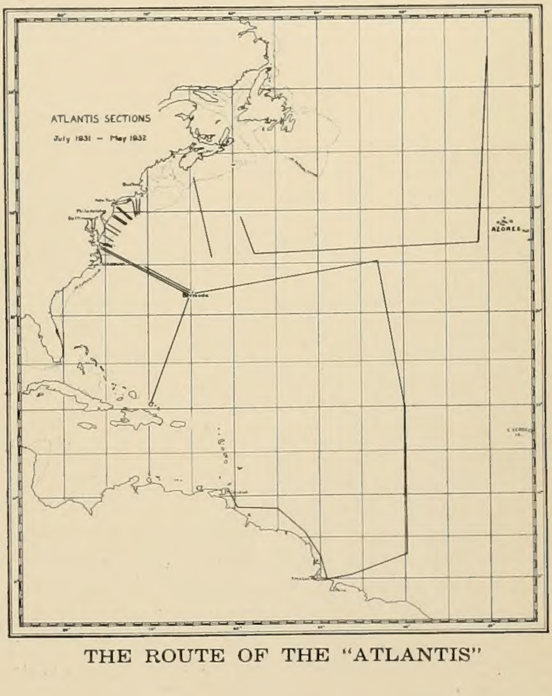
In November the first of the quarterly Bermuda cruises took place. The route chosen gave two sections, one from Nova Scotia to Bermuda and the other from Bermuda to the mouth of Chesapeake Bay. Mr. Seiwell again made pH and phosphate determinations at all the stations. In this cruise the first heavy weather was experienced, and the vessel behaved satisfactorily in spite of the fact that every effort was made to run the sections at full speed in order to get as near a simultaneous picture as possible. It is planned to repeat these sections four times a year until a satisfactory picture of the annual changes in the ocean has been obtained.

These three preliminary cruises having proved that the *Atlantis* could accomplish what she was sent out for, preparation was made for a more ambitious expedition, which started early in February. Here the main objective was a section extending from about 35° N to the equator and therefore crossing the northeast trade wind belt and the northern Equatorial Current. At the same time it was possible to secure two good sections between Bermuda and Chesapeake Bay and a third crossing the Antilles Current.

Again Mr. Seiwell was in charge of the chemical program, and this time all water samples were analized for oxygen as well as pH and phosphate. A special feature of his work was a chemical section along the equator giving the changes experienced as we saidel from oceanic water into the influence of the Amazon River. Throughout the cruise he also made accurate vertical plankton hauls with a special net of fine monel metal screening, in order to correlate the distribution of plankton with the observed distribution of phosphates.

On this cruise also we began collecting plankton for Dr. Wheeler, Director of the Biological Station at Bermuda, by means of oblique hauls with a two metre net from 250 metres to the surface. The *Atlantis* catches should supplement the plankton work at the Bermuda laboratory and it is hoped that gradually a general study of the distribution of zoo-plankton in the northwestern Atlantic will result.

I have so far failed to make any mention of meteorology. Professor Rossby of the Massachusetts Institute of Technology is in charge of our meteorological investigations. On this last cruise he sent with the *Atlantis* one of his students, who has secured good statistical data of the wind directions in the lower layer of the atmosphere. About 200 balloon ascents have been observed with a special theodolite. It is Prof. Rossby's idea



THE ROUTE OF THE "ATLANTIS"

that by means of this study a value of the frictional force between the wind and the sea surface can be obtained, and thus a better understanding of oceanic wind currents. At the same time a great many evaporation measurements have been obtained besides other more general meteorological observations. I might mention that we have had some trouble aboard the *Atlantis* carrying out the meteorological program. The instruments have not stood up well against the dampness at sea and we have had to go ahead slowly until we were sure just how much effect the sails and deck openings had on the readings obtained in the meteorological shelter.

Finally on her way back up the coast from Chesapeake Bay, the *Atlantis* repeated her survey of last October and at the same time ran two sections from the beach to the 1000 fathom curve, taking bottom samples every two miles. This is in connection with a study of the formation of the continental shelf begun last summer by Mr. H. C. Stetson in the neighborhood of Cape Cod. A new type of bottom sampler is being used which brings up each time a given quantity of the bottom, either sand or mud, in a watertight condition so that none of the fine washings are lost.

Such is the general nature of the work carried out with the *Atlantis* during the last ten months. Of course, it will be some time before the observations can be published, but we can now draw some general conclusions based on our experience at sea. As mentioned before, we are well satisfied with the boat. She will do anything that a vessel of her size can be expected to do. Even in winter we can carry on after a fashion. Especially in the case of hydrographic and chemical work almost nothing can prevent the stations being made provided the route chosen does not involve too much head wind. For biological work heavy weather will always be a great hinderance, Only the strongest nets can stand hard usage. In the same way, meteorological observations are of little value when the spray is flying. There is, moreover, a human problem that will always be hard to solve. It will probably be impossible to find a crew or even scientists who will stand life for even six or eight weeks at a time on a small ship unless they are allowed good rests ashore. In other words, within certain limitations, we can confidently expect the *Atlantis* steadily to progress in the exploration of the sea. Finally, it now seems fairly certain that she can be operated throughout the year and still keep within the $35,000 limit that the budget of the Institution allows.

Although the *Atlantis* is not yet equipped with sonic depth finding apparatus, we have been reminded only too forcibly that oceanographers cannot yet take the depth of the water for granted. We now have a very good wire sounding machine, but with a strong wind or a swift current this method is so uncertain that we have not made sounding a routine part of our work. On several occasions in making a deep station where the chart appeared to show a level bottom, we have brought up the lowest water bottle filled with mud, and twice it has been smashed beyond repair by hard bottom. On the last cruise, while working in a region about 600 miles east of Bermuda where the chart indicated about 2850 fathoms of water, we struck hard bottom when the lowest water bottle could not have been more than 1800 fathoms below the surface. In other words, we struck what must have been a volcanic submarine mountain of fairly recent origin, since it was not covered with mud, and rising more than a mile above the general level of the ocean floor.

The only other results of our last cruise which I can describe at this time, as the records are still incomplete, is part of the north and south temperature section. As shown here the section starts in about 28° N and extends nearly to the equator. Only the observations from the upper 1400 metres have been plotted here, but the temperatures have been corrected for depths so the section is accurate as far as it goes. The northern 300 miles of the section lie in the horse latitudes and although we should expect horizontal isotherms they are here seen slanted so as to indicate a westerly current which checks up with out navigational record for that part of the trip. The central 900 miles of this section lie across the belt of the north-east trades. As we sailed southward, the various isotherms continued to approach the surface, but their slope is by no means constant.

From our navigational record, it is evident that the current was running in streaks. Some days we would experience 15 to 20 miles of westerly current and other days none at all. Apparently the strength and location of these bands of current bore no relation to the strength of the wind along our route. Some indication of the streaky nature of the current can be found in this section, although of course, we will have to wait for the corresponding density profile to be sure. At about latitude 8° N we struck a strong counter current running directly to windward with such strength as to cause tide-rips on the surface. At the time the *Atlantis* was approaching the equator no doldrum belt existed. We ran directly into the south-east trades where we experienced a very strong flow of westerly current. Since this is so near the equator, the strength of the rotational effect of the earth is very weak, therefore we should expect little distortion of the water-layers on the southern end of this section, as is indeed

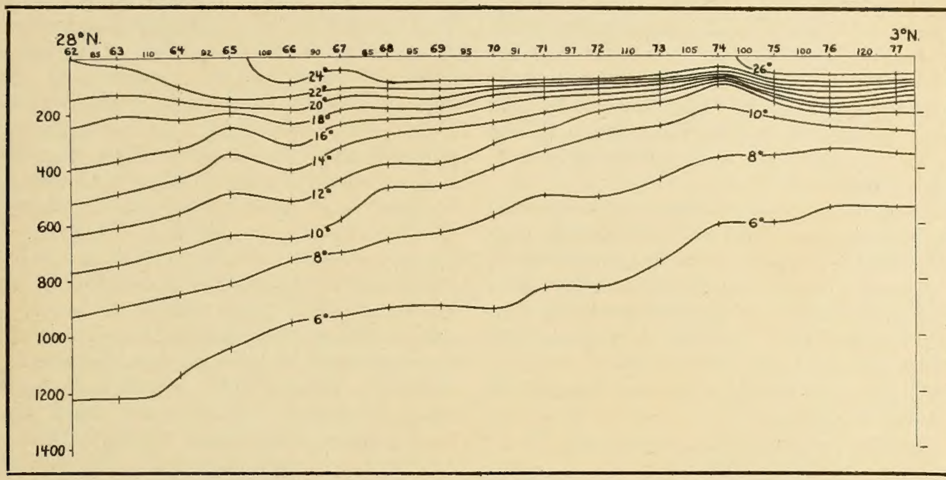


CHART SHOWING THE DISTRIBUTION OF TEMPERATURE
in the surface layers along "Atlantis" route from 28° N latitude to a point near the equator. The depths are shown in metres and the distance between stations in miles.

the case. Apparently there is an immense volume of water flowing in a westerly direction across the belt of the trades, but just how important a part the wind plays in its propulsion is going to take considerable study to find out. Moreover, it is not easy to reconcile this section with Ekman's theory of wind currents.

The researches so far carried out by the *Atlantis* may thus be grouped under the following headings: Dynamic studies of ocean circulation by Franz Zorell and C. O. Iselin; Distribution of oxygen in the water and of phosphorus compounds by Franz Zorell and H. R. Seiwell: Penetration of light and vertical distribution of plankton by Geoerge L. Clarke: Geographic distribution of various planktonic groups.

THE SIXTH INTERNATIONAL CONGRESS OF GENETICS AT ITHACA

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great deal of time and thought to the various difficult problems which have arisen.

The difficulties under which the Congress has been organized can scarcely be overstated. They are a part of its history which should be carefully considered and completely understood by all interested in genetics or by those who are planning to participate in the organization of any international congress of a somewhat similar nature.

During 1929 and 1930, the Council, like most Americans, did not believe that the economic crisis could last. A budget had been fixed on for the Congress and with only one or two exceptions indications were that it could be raised. Many Europeans were expected, the Council voted that the Secretary General should contact a number of the more prominent European geneticists by a European trip in 1930. This trip was taken as planned.

Early in 1931, with economic conditions steadily reaching lower levels and with no possible way of estimating the final outcome, the Council had to make an all-important decision. Those who felt that the present situation was merely temporary urged a postponement of the Congress. The Council, however, after a careful study saw no particular prospect of economic improvement in a one, two, or three year period and, believing that nothing short of war should cause a break in the succession of established meetings, voted to hold the Congress as planned. Its judgment has been justified by the subsequent events. The Congress will be a creditable and representative international meeting. It is to be hoped that before the end of another five-year period the world as a whole will be more normal. In the meantime, realizing that in all probability the United States will not again be host to the Genetics Congress until 1952, it is to be hoped that all American biologists will attend and show their interest in its success.

The Congress is, in point of fact, being splendidly supported by American geneticists in spite of the fact that these are hard times for everyone. There are, on June first, approximately 600 members enrolled. Recently the number of Europeans who expect to attend has been increasingly more encouraging. Many of them are remaining in this country long enough after the Congress to visit and lecture under the auspices of a number of our universities and colleges. The Carnegie Foundation for International Peace is entertaining the foreign members in New York for the period between their arrival and the opening of the Congress. Columbia University has also been most generous in providing space in the dormitories for the few days immediately preceding the Congress.

Because of uncertainty of plans on the part of foreigners, the preparation of the morning programs has been carried on under great difficulties. At the present time, however, the work of preparing the program has progressed until it is possible to announce four specialized morning sessions under the following general titles:

Contributions of Genetics to the Theory of Organic Evolution.

Interrelations of Cytology and Genetics.

Mutations.

Genetics of Species Hybrids.

American participation in the program will be general and gratifying. Dr. T. H. Morgan, President of the Congress, will give his address on "The Rise of Genetics" on Thursday evening, August 25. Some two hundred papers have also been submitted. These will be given during the afternoons in a large number of sub-sections. The latter will be, in so far as possible, based on various special topics. There will be a chairman and a vice chairman for each sub-section. These will act as presiding officers during its meetings. The material covered by the papers to be offered insures a competent and complete treatment of the field as a whole. It also shows the way in which, by a steady process of broadening, the problems of genetics have come to touch the special interests of all the other branches of biological sciences. All zoologists and botanists will find much of interest and importance in the papers listed.

As in the most recent scientific congresses, the exhibits will form a most important feature. The group in charge of the various topics is given below.

ANIMALS

Mammals: Livestock; Department of Animal Husbandry, Cornell University, Ithaca, N. Y. Sheep; E. G. Ritzman, University of New Hampshire, Durham, N. H. Guinea pigs; Sewall Wright, University of Chicago, Chicago, Ill. Mice and Rats; L. C. Dunn, Columbia University, New York, N. Y. Dogs; C. R. Stockard, Cornell University Medical College, New York, N. Y. Leon F. Whitney, 185 Church Street, New Haven, Conn. Cats; P. W. Whiting, University of Pittsburgh, Pittsburgh, Pa. *Birds*: Poultry; W. Landauer, Storrs, Conn. Pigeons; L. J. Cole, University of Wisconsin, Madison, Wisconsin. O. Riddle, Cold Spring Harbor, N. Y. *Fishes*: M. Gordon, Cornell University, Ithaca, N. Y. *Diptera*: Drosophila; M. Demerec, Cold Spring Harbor, N. Y. Sciara; C. W. Metz, Johns Hopkins University, Baltimore, Md. *Lepidoptera*: a. General; John H. Gerould, Dartmouth College, Hanover, N. H. b. Own work; R. Goldschmidt, Kaiser Wilhelm Institut, Berlin-Dahlem, c. Own work; H. Federley, Universitat Helsingfors, Helsinki, Finland. *Hymenoptera*: General; P. W. Whiting, University of Pittsburgh, Pittsburgh, Pa. Habrobracon; P. W. Whiting. *Orthoptera*: R. K. Nabours, Agricultural College, Manhattan, Kansas. *Coleoptera*: Coccinellidae; N. W. Timofeev-Ressovsky, Kaiser Wilhelm Institut für Hirnforschung, Berlin-Buch, Germany. *Aphids*: A. F. Shull, University of Michigan, Ann Arbor, Michigan. *Daphnia*: A. M. Banta, Brown University, Providence, R. I. *Mollusca*: a. General; Capt. C. Diver, 40 Pembroke Square, London. b. Own work; P. Bartsch, U. S. National Museum, Washington, D. C. c. Own work; H. E. Crampton, Columbia University, New York, *Gammarus*: J. S. Huxley and E. B. Ford, King's College, London, England. *Tunicata*: H. H. Plough, Amherst College, Amherst, Mass.

PLANTS

Fungi; S. Satina, Cold Spring Harbor, N. Y. *Sphaerocarpos*: C. E. Allen, University of Wisconsin, Madison, Wis. *Mosses*: F. v. Wettstein. Botanisches Institut, München, Germany. *Ferns*: a. (Nephrolepis); R. C. Benedict, Botanic Gardens, Brooklyn, N. Y. b. Own work; Irma Anderson-Kotto, John Innes Horticultural Inst., Merton Park, London, England. *Phleum* (Timothy); Department of Plant Breeding, Cornell University, Ithaca, N. Y. *Triticum* (Wheat); A. C. Fraser and J. H. Parker, Cornell University, Ithaca, N. Y.—W. J. Sando, Bureau of Plant Industry, Washington, D. C. *Avena* (Oats); W. T. Craig and A. C. Fraser, Cornell University, Ithaca, N. Y. *Hordeum* (Barley); F. P. Bussell, Cornell University, Ithaca, N. Y. Leroy Powers, University of Minnesota, St. Paul, Minn. *Cytology of Cereals;* (individual in charge not selected at time of writing). *Solanum Tuberosum* (Potato); F. J. Stevenson, Bureau of Plant Industry, Washington, D. C. *Solanum Lycopersicum* (Tomato); E. W. Lindstrom, State College, Ames, Iowa. *Gossypium* (Cotton); O. F. Cook, Bureau of Plant Industry, Washington, D. C. *Maize;* F. D. Richey, Bureau of Plant Industry, Washington, D. C. *Maize Cytology;* L. F. Randolph, Cornell University, Ithaca, N. Y. *Fruit Genetics and Breeding;* R. Wellington, Agri. Exp. Station, Geneva, N. Y. *Banana Breeding;* H. Rowe, United Fruit Company, Boston, Mass. *Pineapple Breeding;* J. L. Collins, University of

Hawaii, Honolulu, Hawaii. *Breeding and Genetics of Garden Vegetables;* H. A. Jones, University of California, Davis, Calif. *Antirrhinum;* E. Bauer, Muncheberg, Mark, Germany. *Brassica;* G. D. Karpetchenko, Bureau of Plant Industry, Detskoe Selo, U. S. S. R. C. H. Myers, Cornell University, Ithaca, N. Y. *Capsella;* G. H. Shull, Princeton University, Princeton, N. J. *Crepis;* E. B. Babcock, University of California, Berkeley, Calif. *Cucurbitae;* E. W. Sinnott, Columbia University, New York. *Datura;* A. F. Blakeslee, Cold Spring Harbor, N. Y. *Delphinium;* M. Demerec, Cold Spring Harbor, N. Y. *Pharbitis;* Y. Imai, Imperial University, Tokyo, Japan. *Linum;* Tine Tammes, Genetisch Institut, Universiteit, Groningen, Holland. *Melandrium;* O. Winge, Rolighedsvej 23, Copenhagen, Denmark. *Mentha;* M. L. Ruttle-Nebel, Agri. Exp. Station, Geneva, N. Y. *Nicotiana;* R E. Clausen, University of California, Berkeley, Calif. *Oenothera;* R. E. Cleland, Goucher College, Baltimore, Md. *Oriza;* J. W. Jones, Bureau of Plant Industry, Washington, D. C. *Papaver Rhoeas;* John Innes Hort. Inst., Merton Park, London, England. *Pine and Walnut Breeding for Timber Production;* Lloyd Austin, Eddy Tree Breeding Station, Placerville, Calif. *Petunia;* Margaret C. Ferguson, Wellesley College, Wellesley, Mass. *Pisum;* O. White, University of Virginia, Charlottesville, Va. John Innes Hort. Inst., Merton Park, London. *Primula;* John Innes Hort. Inst. Merton Park, London. *Sorghum;* John H. Martin, Bureau of Plant Industry, Washington, D. C. *Viola;* J. Clausen, Carnegie Institute, Palo Alto, Calif. *General Cytology;* R. E. Cleland, Goucher College, Baltimore, Md. *Disease Resistance;* W. H. Burkholder, Cornell University, Ithaca, N. Y. *Genetic Work with Wild Species;* Edgar Anderson, Bussey Institution, Jamaica Plain, Mass. *Radiation and Genetics;* C. P. Oliver, Washington University, St. Louis, Mo. *Varieties Recommended by State Crop Improvement Associations;* H. K. Hayes, University of Minnesota, St. Paul, Minn. F. D. Richey, Bureau of Plant Industry, Washington, D. C. *Improvement in Cultivated Varieties of Plants;* (Individual in charge not selected at time of writing). *Amount of Genetic Work Done with Several Groups of Animals and Plants;* C. H. Danforth, Leland Stanford University, Palo Alto, Calif. *Materials for Elementary Courses in Genetics;* E. Dorsey, Cornell University, Ithaca, N. Y. *Biological Books and Publications;* Various Publishers.

Ithaca—now well used to international scientific meetings—provides an ideal setting for the Congress. Headquarters will be at Willard Straight Hall. The Administration of Cornell University has quoted rates in residential halls for a period of four to seven days, of $1.75 per day. Private rooming houses, adjoining the campus quote rates of from $1.00 to $1.50 per day, depending on the facilities offered and length of occupancy. It is planned to publish, during the early summer, a more detailed survey of facilities and rates for the information of members. The replies to this will serve as a guide in making final arrangements.

It is hoped that as many American members as possible may come by motor. In this way they can do much to facilitate, without extra expense to themselves, the entertainment and local transportation of foreign members.

It is planned to avoid, in so far as possible, formal social functions. These will be replaced by such group picnics or informal smokers or meetings as may be desired by members with special interests. The Council has felt that much of the benefit of international meetings of this sort is to be derived from personal contacts. Conference rooms for small meetings and discussions will be available to members.

The Proceedings of the Congress will be published as a supplement to *Genetics*. By the interest and cooperation of those in charge of that publication, an excellent arrangement has been possible. Active members will receive complete Proceedings. Institutional members receive two copies. The Institutional members at present are as follows: American Fruit Growers, American Guernsey Cattle Club, Armour and Company, Association of Hawaiian Pineapple Growers, Brown University, Bucknell University, California Institute of Technology, Carleton College, Columbia University, Cornell University, Dartmouth College, Eddy Tree Breeding Station, Gallatin Valley Seed Company, General Electric Company, General Mills, Inc., Goucher College, Harvard University, Hawaiian Sugar Planters Association, Johns Hopkins University, Minnesota Crop Improvement Association, New York College of Agriculture of Cornell University, Pillsbury Flour Mills Company, Russell-Miller Milling Company, Smithsonian Institution--U. S. National Museum, Texas Agricultural Experiment Station, Tri-State Soft Wheat Improvement Association, University of Chicago, University of Missouri.

In addition to the support of the Congress by these institutions, the Carnegie Corporation of New York, and the Carnegie Institute of Washington have contributed generously to its budget.

The Congress has, since June 1930, published a quarterly folder to keep those interested informed of its plans and progress. Copies of most of the back numbers of this can be obtained by writing to R. C. Cook, the Treasurer of the Congress, at 306 Victor Building, Washington, D. C. Particulars regarding membership can be obtained from the Secretary General, Box 558, Bar Harbor, Maine. There are special reduced rates for graduate students and assistants.

THE COURSE WORK AT THE MARINE BIOLOGICAL LABORATORY

PROTOZOOLOGY COURSE

Dr. Gary N. Calkins
Professor of Protozoology, Columbia University. Director of the Course

Like other courses given at the Marine Biological Laboratory the course in Protozoology is planned to give serious students an introductory course in biological research. The class is limited to sixteen who are chosen on the basis of their preliminary training, maturity, and promise of future usefulness in the field of Zoology. Undergraduates are rarely selected; this is not because of inability to do the actual routine work involved, indeed they are very apt to do better laboratory work than older students, but because of their immaturity and inexperience they are unlikely to see the broad biological bearing of the things they study and the zoological import of the things they hear in the six weeks of concentrated work during which there is little time for reflection.

In some quarters Protozoology appears to mean little more than knowledge of the minute animal parasites of man and other animals. This, indeed, is a big field in Protozoology involving the relatively few forms which have become adapted to a parasitic mode of life from the vast aggregate of Protozoa. These parasitic forms demand little knowledge of the group as a whole but essential phases of their study are the pathological effects produced on their hosts, the serological aspects in the host-parasite relationship, and the economic and hygienic aspects involved in the control and prevention of disease.

In much the same way that pathology, bacteriology and epidemiology have been forced to take cognizance of the parasitic Protozoa, so are the great problems, principles and generalizations of biology applicable to that enormous world of free-living, minute animals which we call the Protozoa. Problems of development and differentiation; cytological problems concerning chromosomes, centrioles and the mitotic figure, or make-up of the cytoplasmic body in mitochondria, Golgi apparatus and other constituents of the cell; problems dealing with the functions of these various cellular parts and the physiology of the organism as a whole, or the special physiology and biophysics of protoplasm; problems of genetics, opening up an entirely new field for experimental work; problems of ecology, distribution and adaptation and problems in comparative morphology and taxonomy; all of these problems and many more connected with experimental zoology, animal behaviour and others, are as applicable to free-living Protozoa as to any other group of animal forms. For training the power of observation finally, there is no better practice than to make out the minute differences in structure which characterize different genera and species. All of these matters and many of more special nature dealing with life histories, phenomena of fertilization and preparation for it through maturation processes, protoplasmic age and its significance, etc. are extensively treated in the didactic work of the course.

The laboratory work under the direction of Dr. Bowling has been adapted to satisfy the preliminary requirements of students who may wish to do research in any of the fields of activity mentioned above. Some idea of the nature of this practical training may be obtained by the following outline of the laboratory schedule which has been adopted for this year's work.

Laboratory Requirements In Protozoology—1932

June 22. Make arrangements for microscopes in Main Office. Procure necessary supplies: slides, cover-slips (No. 1 for permanent preparations, No. 2 for the study of fresh material), slide labels, slide boxes, index cards (4″ x 6″) for drawings.

Calibrate objectives. See Laboratory Outline for directions. Slide micrometers will be found on the laboratory table. Read pages 144-153 in the "Biology of the Protozoa" (Calkins).

June 23. Make detailed drawing of Hypotrich (Euplotes). See sample drawing in outline. Study all structures and determine the diagnostic characters of the Class, Order, Genus, et cetera. List these on the back of the card. (It will not be necessary to do this in other drawings.) Important structures should be drawn and labelled. Hand in Friday morning, June 24th.

A Collecting Trip will be taken to various fresh and brackish ponds.

June 24. *Isolation Cultures*: (15 consecutive days) See Laboratory Outline for directions. Make up media and put aside for use on June 25. Make pipettes and see that isolation dishes and moist chambers are in readiness. Keep a complete record of daily divisions, media, temperature, et cetera. Start cultures on the 25th and hand in records on Saturday, July 16th.

pH Records: Determine the pH of Bear Mt. Spring water, media used for isolation cultures, and water from Cedar Swamp and Mill Pond. Hand in records before July 20th.

June 26. *Mass Cultures*: Start mass cultures of at least four organisms. Try various types of media (different dilutions) until successful results are obtained. These cultures will serve as material for fixed preparations later in the course. Hand in record of the forms cultivated, the length of time, and media used.

June 24 to July 29. *Drawings*: 75 drawings of living organisms are required. (If the student has difficulty in determining particular structures, it is permissable to use stains or reagents (acid fuchsin, magenta, methyl green, acetic carmine, iodine, etc.) to bring out these details more clearly. Protozoa treated in this way are frequently distorted, hence this method should be used only to supplement the study of the living material. As far as possible these drawings should represent the main groups and orders. All organisms thus drawn should be classified as to *genera* and of these, *ten* should be classified through *species*. They should show clearly the characters by which the genus (or species) is determined.

June 30. Five drawings are due at noon.

July 12. Twenty-five drawings are due at noon.

July 29. Forty-five drawings are due at noon.

Vital Dyes: Five of the above drawings should be made from living organisms stained with dilute dyes. The stained elements of the cell should be indicated on the drawing. The dyes used should include Neutral red, Janus green B, and Nile blue sulphate. Other vital dyes will be found on the laboratory table.

July 12 to July 29. *Permanent Preparations*: Ten acceptable preparations are required. These should include a and b; (c, d, e and f are optional)

a. Iron hematoxylin after Schaudinn's fixative
b. Feulgen nucleal reaction
c. Chondriosome methods — (Champy-Kull or Champy-hematoxylin)
d. Osmic methods (Kolatchev, Weigl, et cetera)
e. Borrel stain after Bouin
f. Klein's silver impregnation methods.

The protozoan fauna at Woods Hole is amazingly rich; brackish waters abound with them while marine forms are plentiful, and fresh water ponds, equally rich in forms are easily reached, hence dearth of material is unknown. In addition to the free-living forms there is a harvest of parasitic types waiting to be found and studied; indeed it would be a great achievement to find even one species of invertebrate animal in and around Woods Hole that does not play the part of host to one or more types of parasitic Protozoa.

The course counts as a summer session course for credit towards the higher degrees at Columbia University. We are glad to welcome Dr. Robert M. Stabler from the University of Pennsylvania, and a former student in the course at Woods Hole, to the staff.

EMBRYOLOGY COURSE

Dr. H. B. Goodrich

Professor Biology at Wesleyan University, Director of the Course.

The Embryology course opened on Wednesday, June 22. The schedule will be similar to that of last year as it is necessarily adjusted to the breeding season of the various forms available at Woods Hole. Our schedule, though at present only a tentative one, will be found at the end of this account.

Because their spawning season will soon close, the work begins with the embryology of fish. Fundulus, the cunner and mackeral are the types usually studied. This is followed by work on such coelenterates as are obtained early in the season, but gonionemus and other types will be used toward the end of the course.

Another condition which affects the plan of the laboratory work is the breeding period of nereis which runs from full moon to new moon. Other forms studied are examples of the annelids, mollusca, echinoderms, crustacea and tunicates. Living material is used almost exclusively and this fact alone makes the course quite different from courses that are given during the winter in inland institutions. It is hoped that various investigators will, from time to time, present results of their work to the class. This has always been one of the most stimulating features of the course.

Following the practice of the last few years, the laboratory will reserve a few research tables for students who, during the course, show evidence of special ability and who may desire to remain and work on some approved problem.

There has been one change in the staff due to the resignation of Dr. Harold Plough of Amherst College, who has been an instructor for nine summers. His place is taken by Dr. L. G. Barth of Columbia University.

The tentative schedule is given below:

LECTURES

June 22, Wed. Introductory instructions, General embryological problems, Dr. Goodrich

23, Thu. Comparative fish embryology, Dr. Goodrich

24, Fri. Comparative fish embryology, Dr. Goodrich

25, Sat. Structure and function in the developing pro-nephros in teleosts, Dr. Armstrong

26, Mon. Interrelations of genetics and embryology with special reference to investigations on fish, Dr. Goodrich

LABORATORY WORK

June 22,	Wed.	Fish	Goodrich
23,	Thu.	"	"
24,	Fri.	"	"
25,	Sat.	"	"
26,	Sun.	———	
27,	Mon.	"	"
28,	Tue.	Coelenterata	Barth
29,	Wed.	"	"
30,	Thu.	Fertilization and cell lineage	Packard
July 1,	Fri.	"	"
2,	Sat.	"	"
3,	Sun.	———	
4,	Mon.	———	
5,	Tue.	Annelids and Mollusca	Grave
6,	Wed.	"	"
7,	Thu.	"	"
8,	Fri.	"	"
9,	Sat.	"	"
10,	Sun.	———	
11,	Mon.	Squid	"
12,	Tue.	"	"
13,	Wed.	Excursion	
14,	Thu.	Echinoderms	Hoadley
15,	Fri.	"	"
16,	Sat.	"	"
17,	Sun.	———	
18,	Mon.	"	"
19,	Tue.	"	"
20,	Wed.	"	"
21,	Thu.	Coelenterata	Barth
22,	Fri.	Tunicates	"
23,	Sat.	"	"
24,	Sun.	———	
25,	Mon.	"	"
26,	Tue.	"	"
27,	Wed.	Crustacea	Packard
28,	Thu.	"	"
29,	Fri.	Towing	Staff

THE PHYSIOLOGY COURSE

Dr. Laurence Irving

Associate Professor of Physiology, University of Toronto, Director of the Course

The course in physiology began work on July 16 with eighteen students. The same staff as that of last year continues to direct the course, with the assistance of Dr. C. Ladd Prosser and Mr. A. L. Chute. The formal management of the course for this year has rotated to Dr. Laurence Irving of the University of Toronto.

As in previous years each member of the staff presents a choice of several experiments which are designed along the lines of his own research interests. The student selects from these experiments and develops a few of them intensively. The time, facilities and direction are in this way adequate to give considerable experience with a few of the methods which are being used in current research. There is no attempt to spread the instruction over a comprehensive course, but the range of subjects offered is quite broad. The subjects are: (1) the significance of electrical conditions in tissues, *Dr. Amberson;* (2) the central nervous system and heart, *Dr. Bard;* (3) the acid base equilibrium in sea water and tissues, *Dr. Irving;* (4) cell and tissue respiration processes, *Dr. Gerard;* (5) potentiometric determination of hydrogen ion concentration and of oxidation-reduction systems, *Dr. Michaelis;* and (6) electrical conditions at membranes in relation to permeability, *Miss Sumwalt.*

A lecture is given at nine o'clock each morning. The first lectures are given by members of the staff for the course and will occupy about three weeks. It is planned to develop a subsequent group of lectures by other investigators on the relation of membrane electrical states to permeability. Members of the institution are welcome to attend any of the lectures.

THE INVERTEBRATE ZOOLOGY COURSE

Dr. Elbert C. Cole

Associate Professor of Biology, Williams College Director of the Course

The course in Invertebrate Zoology provides opportunity for the study of representative marine invertebrates. Both structural and functional aspects are kept in mind, and appropriate records of observations and experiments are made. The work in the field is an integral and important part of the course, consistent with the concept that the organism cannot be fully comprehended apart from its environment. Field trips are so planned as to give the student an acquaintance with the more common types of marine habitats, as well as some knowledge of the forms characteristic of each. The use of a check list of the invertebrate animals of the Woods Hole region aids materially in this work. It has been customary to prepare one or more exhibits of living invertebrates secured by the class during field trips. The labor involved in preparing such demonstrations has been more than offset by the interest shown by members of the laboratory community.

The regular lectures in this course provide the necessary introduction to the laboratory and field work. Furthermore, they aim to outline some of the more significant fields of research among the invertebrates. In addition to the regular lectures, which are necessarily concerned with specific groups of organisms, a number of special lectures having a broader scope are usually given. During this season these will include the lectures: "Marine Zoology" by Dr. A. W. Pollister, "The Ecology of Marine Invertebrates", by Dr. L. P. Sayles, and "Phylogeny of the Invertebrates" by Dr. A. E. Severinghaus.

THE CHEMICAL ROOM

DR. OSCAR W. RICHARDS

Instructor in Biology, Yale University. In Charge of the Chemical Room.

Hours: Mon. — Fri. 8:30 A. M. - 12:00 M.; 1:30 - 4:30 P. M. Sat. 8:30 A. M. - 12:00 M.

The Chemical Room supplies chemicals, glassware, clamps and support stands for use only at the Marine Biological Laboratory. Special apparatus, batteries, gauges and reducing valves for gas cylinders are issued at the Apparatus Room (Brick Bldg. room 216). Supplies that are to be used by investigators elsewhere, such as microscope slides, cover glasses, shell vials, etc., may be obtained at the Supply Department (Frame Bldg. back of Brick Bldg.) *Catalogs* of chemicals and apparatus *may be borrowed from the Apparatus Room.*

The following standardized solutions will be furnished in limited quantities during the season of 1932. Special solutions, buffers, glass distilled water, and pH standards should be ordered at least *two days* before they are needed.

N 1.000

Acetic acid	Sulphuric acid
Hydrochloric acid	Sodium Hydroxide

N 0.100:

Hydrochloric acid	Sodium hydroxide

Buffer mixtures:

Acetate pH 3.6-5.6	Borate pH 7.6-10.0
Phosphate pH 5.4-8.0	

Acetate-citrate pH 2.2-8.0 (McIlvaine)

Indicators—Clark and Lubs series.

Color tube standards—on special order.

Glass distilled water—on special order.

Compressed gases:

Carbon dioxide, hydrogen, nitrogen and oxygen must be ordered by the investigator from the person in charge at least *ten days* before they are needed.

For other standards inquire of the person in charge at the Chemical Room. Investigators expecting to use special solutions or standardized reagents after September 1 are requested to notify the Chemical Room, if possible, before August 15. The standardized reagents are not usually available before June 20 or after September 15.

Attention is invited to the *Formulae and Methods* published by the Chemical Room in THE COLLECTING NET (1930) for the composition of solutions and stain solubilities. Copies may be obtained at THE COLLECTING NET office.

Members of classes are not entitled to supplies other than those provided in their regular class work. Beginning investigators will receive supplies only on the authorization of the person under whom they are working for the season.

Certain common tools are available at the Chemical Room for temporary loan to investigators. In order that maximum use be made of these, it is necessary that they be returned within 24 hours. When needed by other investigators they are subject to recall and will then be collected by the janitors.

Supplies no longer needed will be collected if word is left at the Chemical Room.

Investigators are urged to co-operate with the Chemical Room by cleaning their glass-ware before returning it at the completion of their work. If the investigator will place his name on the Bulletin Board of the Chemical Room the janitors will return his supplies on the date indicated.

When the investigator is continuing the same work in the same room during the next season his supplies may be retained in the room *only* if they are listed on a Kept Out card (furnished at the Chemical Room window) and the card left with the supplies. All supplies not so listed will be returned by the janitors. Should the investigator be unable to return the following summer the supplies will be returned to the Chemical Room stocks if they or the room is needed by other investigators.

Small amounts of special solutions will be kept during the winter for investigators in the Chemical Room on request. Supplies that may be injured by freezing should not be left in the wooden buildings.

THE MECHANICAL DEPARTMENT OF THE MARINE BIOLOGICAL LABORATORY

Thomas E. Larkin

Superintendent of the Mechanical Department

The M. B. L. electrical equipment has had extensive changes and additions during the past spring months, which will no doubt be of great benefit to the many investigators working here, by maintaining a more constant voltage on the direct current circuits, and giving them a much greater source of alternating current throughout the entire laboratory.

The large storage battery plant has had a complete overhauling, with a set of new plates to replace the older ones, thereby bringing the outfit up to its initial point of efficiency. We also have installed in the main switch board room a new type of equipment, a motor generator set of seven kilowatts, known as a buck and boost set, which will build up or buck the voltage on the main buzzy bars if it is above or below the 115 volts that the device is adjusted for, thereby maintaining a constant potential of 115 volts at all times throughout the entire laboratory.

By eliminating 90% of the light load from the battery, it has been possible to cut the capacity of the battery down to 60%, of its original rating, with a working force at present of 800 ampere hours.

Two new cables have been pulled in from the substation to the main switch board room to carry the A. C. current from new transformers and other necessary equipment situated there to supply the demand of the many changes made necessary by switching over much of the D. C. load to A. C.; such as lights, stills, ovens and many other types of laboratory equipment that is possible to use on current rather than from the battery.

The new brick building has had all its lights transferred to town current, with the result that we now have two A. C. circuits available for experimental work, instead of one, as in the past.

The older buildings, such as the Rockfeller and Botany buildings, the Lecture Hall, Kidder House and Homestead have all been transferred to A. C., direct from our own transformers, and this will show quite a saving from our old system, as well as a much more even potential.

We have retained D. C. throughout the Old Main building, Mess and Carpenter Shops, since much of the equipment in these buildings is dependent on direct current only.

The Crane building has also changed back to its old A. C. system throughout, with the exception of a few rooms on the third floor. These four are fitted up with one or two D. C. polarity plug outlets. Also one of the 15 H. P. direct current S. W. pump motors has been replaced with a new 20 H. P. 220 Volt A. C. motor that will now be available for pumping throughout the whole 24-hour period. This is a big asset to the laboratory, because the demands for salt water are so many and so very important that a steady flow must be maintained at all times.

During the past years, we could not run these pumps during the peak hours of the Cape and Vineyard Electric Company, which extended over a period of from 8 P. M. to 12 M.—a big handicap to everyone working with salt water.

Finally, I believe we will all find that the whole plant in general is in much better shape to carry on the various needs of the institution, than at any time in the past.

THE SCIENCE SCHOOL

This summer the children's School of Science will again be open to the children of both summer and all-year-round residents of Woods Hole and Falmouth. At Woods Hole, where there is a large majority of people interested in biology, there is an opportunity to cultivate this interest in their children. There are classes in Nature Study, Biology and Elementary Zoology for all children seven years old and over; and there are advanced classes for those through high school age in Biological Technique and General Science. Under proper supervision, individual problems may be worked upon. The fee for attending the School is an amount which varies according to the means and interest of the applicants.

Registration for classes is on Friday, June 24, at the School. The classes begin on Monday, June 27, and continue until August 5. Mrs. Clower is President of the Executive Committee and Mrs. Compton is the Chairman of Science.

The staff consists of: Miss Katherine Clark and her sister Mrs. Alice C. Mullen, who have been connected with the School for about 10 years, Miss Elizabeth Kinney and Mrs. Victor Crowell, Jr. It is doubtful whether Mr. George Hutchinson will return.

Preliminary
DIRECTORY FOR 1932

The following number of THE COLLECTING NET will contain a directory of the scientific workers associated with the three scientific institutions in Woods Hole during the present summer. In this final directory the new names will be combined with those listed below. No additional names can be accepted after Wednesday, July 2, and it will be of great assistance if the directory cards can be filled out much sooner. We shall be under great obligations to all members of the laboratories if they will cooperate fully in this manner, so that the directory will be as complete as possible.

KEY

Laboratories		Residence	
Botany Building	Bot	Apartment	A
Brick Building	Br	Dormitory	D
Lecture Hall	L	Drew House	Dr
Main Room in Fisheries Laboratory	M	Fisheries Residence	F
Old Main Building	OM	Homestead	Ho
Rockefeller Bldg.	Rock	Hubbard	H
		Kahler	Ka
		Kidder	K
		Whitman	W

In the case of those individuals not living on laboratory property, the name of the landlord and the street are given. In the case of individuals living outside of Woods Hole, the place of residence is given in parentheses.

MARINE BIOLOGICAL LABORATORY
INVESTIGATORS

Amberson, W. R. prof. phys. Tennessee. Br 309. D 111.
Armstrong, P. B. asst. prof. anat. Cornell Med. Br 318. A 106.
Baitsell, G. A. prof. biol. Yale. Br 323. Brooks.
Bard, P. asst. prof. phys. Harvard Med. Br 109. D 306.
Barth, L. G. instr. expt. emb. Columbia. Br 111. D 206.
Beck, L. V. asst. phys. Pittsburgh. Rock 2. McLeish, Milfield.
Boyden, Louise E. edit. asst. "Biol. Bul." Br 305. Young, West.
Brinley, F. J. asst. prof. zool. North Dakota State. OM 39. D 102.
Brooks, Matilda M. res. assoc. biol. California. Br 233. Gosnold.
Brooks, S. C. prof. physico-chem. biol. California. Br 306. Gosnold.
Butt, C. res. asst. phys. Princeton. Br 116. White, Milfield.
Calkins, G. N. prof. proto. Columbia. Br 331. Buzzards Bay.
Castle, W. A. instr. biol. Brown. OM 3. Kittila, Bar Neck.
Cattell, W. assoc. ed. "Scientific Mo." Br 344. A 102.
Chidester, F. E. prof. zool. West Virginia. Br 344. D 318.
Child, G. P. asst. instr. biol. New York. Br 1. A 108.
Chute, A. L. asst. phys. Toronto. phys. D 107.
Clowes, G. H. A. dir. Lilly Res. Labs. Br 328. Shore.
Coe, W. R. prof. biol. Yale. Br 323. A 201.
Cohen, Rose S. grad. asst. zool. Cincinnati. L 29. H 6.
Cole, K. S. asst. prof. phys. Columbia. Br 343. D 216.
Cowles, R. P. prof. zool. Hopkins. Br 340. D 315.
Crampton, Clair B. res. asst. biol. Wesleyan. Br 210. K 5.
Croasdale, Hannah T. asst. bot. Pennsylvania. Bot. 23. H 9.
Crummy, P. L. grad. asst. zool. Pittsburgh. Rock 7. McLeish, Milfield.
Dan, K. grad phys. Pennsylvania. Br 110. Eldridge, Main.
Darlington, C. D. cytologist. John Innes Hort. Inst. (London). Br 122 A. McLeish, Milfield.
Doyle, W. L. res. asst. zool. Hopkins. Br 329. Dr 6.
Fish, H. S. grad. biol. Harvard. Br 315. Dr 1.
Fry, H. J. prof. biol. New York. OM Base. Purdum, Falmouth.
Garrey, W. E. prof. phys. Vanderbilt Med. Br 215. Gardiner.
Goodrich, H. B. prof. biol. Wesleyan. Br 210. D 110.
Goodson, Mary L. Barnard. Br 344. A 102.
Grave, B. H. prof. zool. DePauw. Br 234. Grave, High.
Grave, C. prof. zool. Washington (St. Louis). Br 327. High.
Guerlac, H. E. asst. phys. Cornell. OM 5. Cowey, Quisset.
Hahnert, W. F. Nat. Res. fel. biol. Hopkins. Br 111. Ka 21.
Harnly, Marie L. asst. biol. New York. Br 1. D 202.
Harnly, M. H. asst. prof. biol. New York. Br 1. D 202.
Harryman, Ilene res. asst. chem. Lilly Res. Labs. Br 319. D 103.
Harvey, Ethel B. independ. invest. phys. Princeton. Br 116. Gosnold.
Harvey, E. N. prof. phys. Princeton. Br 116. Gosnold.
Heilbrunn, L. V. assoc. prof. zool. Pennsylvania. Br 221. Schramm, Gardiner.
Hill, E. S. res. asst. phys. chem. Rockefeller Inst. Br 206. D 316.
Hill, S. E. asst. gen. phys. Rockefeller Inst. Br 209. Veeder, West.
Hook, Sabra J. asst. prof. biol. Rochester. Br 217a. K 2.
Hoppe, Ella N. res. asst. biol. N. Y. State Dept. Health. Br 122B. A 207.
Huettner, A. F. prof. biol. New York. Br 228. Gansett.
Irving, L. assoc. prof. phys. Toronto. Br 109. Amberson. Quisset.
Jackson, J. R. grad. asst. biol. Missouri. Bot 1st Floor. K 10.
Jenkins, G. B. prof. anat. George Washington. Br 33. Cannan, Gardiner.
Johlin, J. M. assoc. prof. biochem. Vanderbilt Med. Br. 336. Park.
Keil, Elsa M. instr. zool. N. J. Col. for Women. Br 8. W d.
Kaliss, N. grad. zool. Columbia. Br 314. McLiesh, Milfield.
Keltch, Anna K. res. chem. Lilly Res. Labs. Br 319. Duff, Milfield.
Kinney, Elizabeth T. lect. zool. Barnard. Br 217b. K 3.

Kirkpatrick, T. B. assoc. prof. physical education. Columbia. L 26. Nickerson, Milfield.
Knower, H. McE. assoc. prof. anat. Albany Med. Br 234. Buzzards Bay.
Knowlton, F. P. prof. phys. Syracuse Med. Br 226. Gardiner.
Krieg, W. J. S. instr. anat. New York. OM 34. Elliot, Center.
Lackey, J. B. prof. biol. Southwestern (Memphis). Br 8. A 203.
Landowne, M. fel. biol. Col. City N. Y. Br 122c. Ka 22.
Laug, E. P. instr. phys. Pennsylvania. Br 8. D 302.
Lillie, F. R. prof. zool. Chicago, Br. 101. Gardiner.
Lillie, R. S. prof. gen. phys. Chicago. Br 326. Gardiner.
Lynch, Ruth S. instr. genetics. Hopkins. Br 127. D 201A.
Magruder, S. R. grad. asst. zool. Cincinnati. L 29. Kittila, Bar Neck.
Marsland, D. A. asst. prof. biol. New York. Br. 339. D 106.
Mathews, A. P. prof. biochem. Cincinnati. Br 342. Buzzards Bay.
Mazia, D. Pennsylvania. Br 221. Ka 23.
Michaelis, Eva M. res. asst. phys. Columbia. Br. 114. Gansett.
Michaelis L. mem. Rockefeller Inst. Br 207. Gansett.
Miller, F. W. grad. asst. zool. Pittsburgh. Rock 7. K 15.
Nicoll, P. A. grad. asst. zool. Washington. Br 225. Dr 2.
Nonidez, J. F. asst. prof. anat. Cornell Med. Br 318. Whitman.
Pace, D. M. res. asst. phys. Hopkins. Br 329. Russell, (Bourne).
Packard, C. asst. prof. zool. Columbia Inst. Cancer. OM 2. North.
Pomerat, C. M. instr. biol. Clark. Higgins, Depot.
Pond, S. E. prof. phys. Pennsylvania Med. Br 216, Gansett.
Poole, J. P. prof. evolution. Dartmouth. Bot 25. D 305.
Prescott, G. W. asst. prof. bot. Albion. Bot 22. D 107.
Prosser, C. L. fel. zool. Harvard Med. Br 109. Dr 6.
Richards, O. W. instr. biol. Yale. Br 8. A 303.
Robert, Nan L. instr. zool. Hunter. Br 217. A 206.
Root, W. S. assoc. prof. phys. Syracuse Med. Br 226. Erdwurm, High.
Rugh, R. instr. biol Hunter. Br 111. D 308.
Sichel, F. J. M. asst. biol. New York. Br 338. Dr 2.
Smith, E. L. grad. zool. Columbia. Br 314. Dr 34.
Sonneborn, T. M. res. assoc. zool. Hopkins. Br 127. D 201.
Speicher, B. R. grad. asst. zool. Pittsburgh. Rock 7. K 15.
Speidel, C. C. prof. anat. Virginia. Br 106. D 104.
Stabler, R. M. instr. zool. Pennsylvania. OM 22. Whiting, Minot.
Starkey, W. F. grad. zool. Pittsburgh. Rock 7. Dr attic.
Stewart, Dorothy R. asst. prof. biol. Skidmore. Br 232. D 105.
Stockard, C. R. prof. anat. Cornell Med. Br 317. Buzzards Bay.
Sumwalt, Margaret asst. instr. phys. Pennsylvania Med. Br 232. D 105.
Tang, P. S. instr. gen. phys. Harvard. Br 309. D 305.
Tashiro, S. prof. biochem. Cincinnati. Br 341. Park.
Taylor, J. W. Nat. Res. fel. phys. Princeton. Br 116. Cowey, School.
Taylor, W R. prof. bot. Michigan. Bot 24. Whitman.
Titus, C. P. dir. Sch. Microscopy (N. Y.) OM Base. D 213.
Townsend, Grace fel. zool. Chicago. Br 217i. W b.
Wade, Lucille W. asst. Lilly Res. Labs. Br 319. Robinson, Quissett.
Walker, P. A. grad. asst. phys. Harvard. Br 312. Thompson, Water.
Wilson, E. B. DaCosta prof. emeritus zool. Columbia. Br 322. Buzzards Bay.
Wilson, Hildegard N. fel. biochem. Bellevue Med. Br 310. Buzzards Bay.
Te Winkel, Lois E. grad. zool. Columbia. Br 314. K 2.
Wolf, E. A. assoc. prof. zool. Pittsburgh. OM 43. Elliot, Center.
Young, S. B. tech. Rockefeller Inst. Br 209. Young, Middle.
Zirkle, C. assoc. prof. bot. Pennsylvania. Bot 6. Boss, West.

STUDENTS

Belcher, Jane C. grad. Colby. emb. H 3.
Beltran, E. prof. zool. Mexico. proto. D 203.
Bridges, J. C. instr. biol. Michigan. phys. A 106.
Burrows, R. B., Jr. grad. asst. biol. Yale. emb. Ka 2.
Chao, I. grad. phys. Chicago. phys. D 217.
Coplan, Helen M. asst. biol. Goucher. phys. H 2.
Cowles, Janet M. Hopkins. emb. D 315.
Dieter, C. D. asst. prof. biol. Washington and Jefferson. emb. Howes, Water.
Duncan, P. M. grad. zool. Pennsylvania. proto. Dr attic.
Eastlick, H. L. grad. asst. zool. Washington (St. Louis). emb. Dr 2.
Gustafson, A. H. instr. biol. Williams. bot. McInnis, Milfield.
Hess, Margaret grad. res. fel. Virginia. phys. McLeish, Milfield.
Heyl, J. T. Hamilton. phys. Ka 24.
Hoover, Margaret E. Smith. emb. Robinson, Quisset.
King, Florence A. grad. asst. phys. Wellesley. phys. H 7.
Kleinholz, L. H. K. instr. anat. Colby. emb. Ka 22.
Ling, S. grad. zool. Cornell. proto. Dr 9.
Manery, Jeanne F. grad. asst. phys. Toronto. phys. H 2.
Morris, J. E. grad. asst. biol. Fisk. emb. K 14.
Olsen, M. W. jr. poultry biol. U. S. Dept. Agr. emb. Ka 23.
Pappenheimer, Anne Radcliffe. phys. H 4.
Roeder, K. D. instr. phys. Tufts. phys. Thomas, Buzzards Bay.
Rowland, C. R. asst. zool. Columbia. proto. Ka 21.
Runelles, R. W. DePauw. emb. Ka 23.
Scartterty, Louise E. instr. biol. Newcomb. emb. H 3.
Schott, Margaret H. asst. phys. Mt. Holyoke. phys. Thomas, Buzzards Bay.
Spangler, Betty A. Wheaton. bot. Young, West.
Specht, H. grad. Hopkins. phys. Dr 5.
Strongman, Louise E. Radcliffe. bot. Gifford, Government.
tum Suden, Caroline grad. res. fel. phys. Boston. phys. Grinnell, West.
Toothill, Martha C. instr. gen. biol. Adelphi. phys. W c.
Wagoner, K. S. grad. DePauw. emb. K 12.
Warbritton, Virgene res. asst. zool. Missouri. phys. Googins, Quissett.
Watkeys, Jean D. Rochester. Med. emb. H 6.
Weintraub, R. L. George Washington. bot. D 312.
Wismer, Virginia asst. bot. Pennsylvania. bot. Sanderson. High.

HERBERT A. HILTON

Those who gather this Summer for work at the Marine Biological Laboratory will miss the pleasant countenance and warm greeting with which Mr. Hilton has for many years met his returning friends. Mr. Herbert A. Hilton from his first connection with the Laboratory in 1912 has been more than a mere employee; an interested and loyal member of the staff of helpers, and in recognition of this intelligent interest, wide general knowledge and the will and ability to place it at the disposal of the Institution, he has since 1915 had the title and responsibilities of Superintendent of Buildings and Grounds.

What investigator during these years has not had occasion to consult him about ways and means of constructing accessory equipment for use either in the laboratory or in the field and has not come away from the conference with a better conceived plan than the one with which he approached Mr. Hilton?

Unusual native abilities were his by Nature but they were schooled and matured by a wide and varied experience; born in Lowell, Massachusetts, in 1867; taken in his first year to Alna, Maine where he spent his childhood and youth and attended the common school. At the age of 15 the serious business of life began which brought him experience on the farm, on the river and in the deep woods of northern Maine. Quick decisions and good judgments were called for in handling scows in the swift currents of the Maine rivers and still more exacting and maturing were the demands of the lumber camp. Driving horse cars for a time in Boston apparently prepared him for the work of teaming on the J. S. Fay farm and for Mr. Walter O. Luscombe during the first years after coming to Woods Hole in 1890. Later he entered the carpenters trade and became foreman for E. E. Swift and Son. Just prior to entering the service of the Marine Biological Laboratory he was associated with the carpenter and builder, Mr. Bowles.

Valuable suggestions and aid could always be expected by those who laid their mechanical problems before the understanding mind and skillful hands of the occupant of the shop on the Eel Pond. Mr. Hilton will be missed and held in pleasant memory by all who have been served by him or were privileged to know him.

—*Caswell Grave.*

THE PENZANCE FORUM

For the past twenty years, weekly informal discussions have been held at the residence of Dr. J. P. Warbasse on Penzance Point, the subjects of which are usually current problems of general interest. Dr. Warbasse usually leads the discussions, although certain distinguished visitors or workers at the Laboratory have often relieved him in this capacity. Some of the men who officiated last summer were Henry Dana, Fred Howe, Roger Baldwin, Everet Dean Martin, and Dr. Stockard and Dr. DuBois from Woods Hole.

This summer it is a question as to whether these forums shall be resumed or not. They have been customarily held out of doors on Sunday afternoons, where chairs are available for those who come early and blankets for the late arrivals. All those who are rather more seriously inclined, and who do not yield to their more frivolous temptations, usually appear at the Point at 3 o'clock. Dr. Warbasse realizes that Sunday afternoons are often too lovely to devote to "education" instead of recreation. For this reason it has been thought that the meetings might be discontinued entirely.

Dr. Warbasse would appreciate very much any suggestions as to subjects for discussion, possible leaders or speakers, and a definite time for these meetings. If the forums were held Sunday evenings, many people who wanted to take the afternoon boat would be unable to; while, if the meetings were to be held on other afternoons, the Laboratory workers ordinarily could not attend. Tuesday and Friday evenings are reserved for the regular evening meetings. The question is, might not much of the charm of outdoor meetings be lost if some evening were appointed for them?

It is hoped that any suggestions that occur to anyone will be communicated to Dr. Warbasse. These will reach him if they are given verbally or in writing to some one in The Collecting Net office.

The Collecting Net

A weekly publication devoted to the scientific work at Woods Hole.

WOODS HOLE, MASS.

Ware Cattell .... Editor

Assistant Editors

Florence L. Spooner Annaleida S. Cattell

The Collecting Net in 1932

The purpose of THE COLLECTING NET is to assemble material which is of especial interest to the workers in the biological institutions at Woods Hole. We want to record as fully as we can the research work and other activities of the members of the Marine Biological Laboratory, the United States Bureau of Fisheries and the Woods Hole Oceanographic Institution. But we also want to seek relevant material outside of Woods Hole and to record local events of interest. The projected editorial contents of our magazine can be divided fairly well into the four parts:

(1) Results of the scientific work reported during the summer at Woods Hole.

(2) Items reporting the activities of members of the scientific institutions in Woods Hole.

(3) World-wide news of the activities of institutions and individuals working in the field of biology.

(4) The more important local news.

THE COLLECTING NET is an independent publication. Its contents are based primarily on the three scientific institutions in Woods Hole, but it has no official connection with any one of them.

We believe that there is not only a place, but a real need for an informal magazine of biology which is prepared to include constructive discussion on any topic of interest to those persons working in the field of the biological sciences.

SCHOLARSHIP AWARDS

Last summer we were successful again in accumulating the sum of $500.00 for THE COLLECTING NET Scholarship Fund. This money was divided into five equal sums and awarded to the following five superior students who took courses at the laboratory during 1931:

Name	*Course*
Mr. J. R. Jackson	Botany
Miss Helen M. Lundstrom	Physiology
Mr. C. M. Pomerat	Zoology
Mr. Thurlo B. Thomas	Zoology
Mr. George D. Young	Zoology

The awards were made to assist these individuals in defraying a part of their expenses in Woods Hole this summer. In accepting a scholarship a student agrees to spend a minimum of six weeks in full-time research. If a student and his advisors believe that he will profit from registering in another course, he may do so providing a period of four weeks is reserved for research work.

The awards listed above were made in September by a committee consisting of Professor C. E. McClung, Professor Alfred C. Redfield and Professor I. F. Lewis.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Investigators

Brown, F. A., Jr. fel. zool. Harvard. 315. Hilton, Milfield.
Hines, J. M. Brown. 211. Stuart, School.
Ingalls, Elizabeth N. tech. Harvard. 103. Young, West.
Lutz, F. B. Brown. 111. Hilton, Water.
Renn, C. E. asst. biol. New York. 201. Young, Middle.
Reuszer, H. W. instr. biol. Rutgers. 201. Young, Middle.
Welsh, J. H. instr. zool. Harvard. 213. McInnis, Milfield.

U. S. BUREAU OF FISHERIES

Galtsoff, Eugenia assoc. zool. George Washington. 122. F 26.
Galtsoff, P. S. biol. U. S. B. F. (Washington) 122. F 26.
Linton, E. fel. parasitology. Pennsylvania. M 5. West.
Worley, L. G. asst. zool. Harvard. Hatchery. F 37.

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
June 25	10:36	11:06
June 26	11:26	..
June 27	12:01	12:14
June 28	12:52	1:02
June 29	1:40	1:47
June 30	2:26	2:31
July 1	3:09	3:13
July 2	3:52	3.57
July 3	4:34	4:40
July 4	5:17	5:24

In each case the current changes approximately six hours later and runs from the Sound to the Bay. It must be remembered that the schedule printed above is dependent upon the wind. Prolonged winds sometimes cause the turning of the current to occur a half an hour earlier or later than the times given above. The average speed of the current in the hole at maximum is five knots per hour.

ITEMS OF INTEREST

The M. B. L. Club

On the evening of Saturday, June 25, the M. B. L. Club will open its doors for the first time this season, with a party known as a "mixer"—to which everyone, member or not, is invited most cordially. It is hoped that everybody connected with any of the three institutions at Woods Hole will take this opportunity to become acquainted with co-workers and fellow pleasure-seekers. Each Saturday night there-after, the Club will be open for informal dances, in which members and their guests only may participate. Every Wednesday night there is to be a victrola concert, the programs for which will be under the direction of Mr. Voss Greenough.

It is stressed that the Club is always open to all members throughout the day, and that reading matter of all kinds is available for the members' convenience.

The membership fee is $1.50, payable to Miss Crowell in the Laboratory Office, and everyone who has not already joined for this season is earnestly urged to do so.

The Club also wishes to announce that the raft which it sponsors is going to be put out in the near future.

The Tennis Club

New visitors and old residents of Woods Hole will be glad to hear that the Tennis Club has started its yearly activities. The courts will all be in good playing order next week, and it is urged that everyone take note of the extensive repairs which have been made on backstops, nets and playing surfaces.

The membership fee for the season is $5.00. If one joins merely for the duration of the courses it is $4.00. Junior membership (for all those under sixteen) is $2.50. All dues are payable to Dr. Arthur Pollister.

In the near future there is going to be held a series of championship tournaments, which will be under the direction of Dr. Pollister, and which will be open to all members. Later it is hoped that the club will be able to include in that tournament a separate one for course members only.

While we are on the subject of clubs, perhaps it is not generally known that there does exist a horse-shoe pitching club—of very small membership at present—but a club which hopes to enlarge that membership this summer. It is understood that the court is to be fixed up, and open to members *only*. The fee for membership is 25 cents. All who may be interested are invited to join.

Dr. Ross G. Harrison, Professor of Zoology at Yale University, sailed for Europe from Montreal on June 11. Dr. Harrison expects to be gone for the entire summer, but will return in time to take up his teaching duties in the Fall.

The *Atlantis* under the command of Captain Iselin, left Woods Hole for a brief cruise on Friday, June 24 and will return on July 3. This vessel is scheduled to take another cruise on July 6 which will extend over a period of only a few days.

Dr. and Mrs. J. M. Johlin have returned to their home on Gardiner Road. Mrs. Johlin has been visiting in Paris, where her two daughters, Miss Ruth Ann and Sally Johlin are now studying. With them is Professor Johlin's cousin Miss Helen Losering of Berne, Switzerland, who is enjoying a year's visit to the United States and Canada. Miss Sally Johlin will be assisting in the Chemical room during the summer.

Mr. Goffin of the fisheries bureau wishes to announce that if anyone in the laboratory wants any goose-fish eggs for experimental purposes, he has some now available. He urges all who may want them to get them now, as they were collected on June 11, and will not last long.

It is reported that Captain Jackson's boat the "Liberty" came in with a haul of about 25 sword-fish last week.

THE LONG ISLAND BIOLOGICAL LABORATORY

The course in Field Zoology opened on June 16th, under the leadership of Profs. S. I. Kornhauser of the University of Louisville, Dr. H. Spieth of the College of the City of New York, and Mr. Howard Curran, of the American Museum of Natural History, assisting. There are twelve students in the course.

The course in General Physiology, with Prof. I. R. Taylor of Brown University in charge and Mr. Crescitelli of the same institution assisting, begins the 21st of this month. Nine students are enrolled.

Students in the class of Surgical Methods in Experimental Biology start work on the 21st. Prof. W. W. Swingle of Princeton University is in charge of the course and will be assisted by Mr. William Parkins of the Biological Laboratory. Twelve students have been admitted to the course, although the number is usually limited to ten.

THE WOODS HOLE LOG
THE FALMOUTH PUBLIC SCHOOLS

Paul Dillingham
Superintendent of Schools

The public schools of Falmouth are organized on the so-called 6-3-3 plan. Four elementary schools located in Woods Hole, Village, Teaticket and East Falmouth, respectively, provide facilities from the sub-primary through the sixth grade. From the elementary schools pupils go to the Junior High School and thence to the high school.

All elementary schools have a sub-primary class. Before these classes were organized the mortality rate in the first grade was high. Now all entering pupils are given an intelligence test and placed where they do the best work, with the result that the mortality in the first grade has been reduced to a minimum. Owing to the number of grades per teacher in the Woods Hole School, the sub-primary class will be discontinued in September.

Three special classes for atypical children have proven their value by removing these pupils from the regular class rooms where they were a handicap and placing them in special classes where the work is adapted to their abilities.

In the Village School we have experimented with an Opportunity Class for pupils who through illness or other misfortune have dropped behind in their work. Over a period of several years this class has brought up to grade annually on an average of forty pupils who would otherwise have had to repeat the grade. The elimination of non-promotion is a subject to which we have given considerable thought, and which after several years' endeavor we feel we are on the road to reducing to a minimum. Non-promotion creates in the pupil a sense of failure and discouragement, and it is very frequently the result of factors beyond his control. The time is not far off when non-promotion will be considered a failure on the part of the school-system to meet the pupils' needs. Where non-promotion is prevalent a pupil repeating a grade has his best subjects depressed to the level of his poorest, while in a school system where non-promotion is reduced to a minimum, an attempt is made to bring a pupil's poor subjects up to the level of his best by permitting him to advance with his class and making provision for extra help in his poorer subjects. In the Village School where an opportunity class has been in operation for four years, the per cent. of non-promotion is negligible, while in the larger elementary schools where this opportunity is not provided, non-promotion and retardation still persist to the detriment of both the pupils and the school system. With an opportunity class in each elementary school, non-promotion in Falmouth could be practically eliminated, the cost of educating a pupil would be materially reduced, and pupils would acquire the habit of success rather than of failure. Unfortunately, owing to a reduced appropriation, our one Opportunity Class will be discontinued in September.

In the Junior High School pupils are offered a course of study which anticipates the high school curriculum, and by exploration discovers the aptitudes of pupils so that they can later follow a course in the high school which is adapted to their needs and abilities. The extra-curricular activities of the Junior High School are an integral part of the school, and upon them are based the pupil participation in school government. The extra-curricular activities range from home-room organization and traffic squad to clubs, orchestra, and assemblies.

At Lawrence High School courses are offered in Household Arts, Manual Training, Commercial subjects, Agriculture, College Preparatory, and a General Course for those who wish to elect subjects from any of the other courses. Several years ago we tried out the Laboratory Plan of instruction in the history department with such good results that the method is now used with other subjects in both the high schools. The so-called Laboratory Plan is an outgrowth of the Dalton Plan which we have adapted to local needs and conditions. A month's work is assigned which the pupil can do at his own rate of speed. When the assignment is completed, the pupil is tested and if the work is satisfactory he may go on to the next month's assignment. The advantages of this system are numerous. The pupil proceeds according to his ability; he knows in advance what he has to do and plans accordingly; his independence is stimulated; and he is trained to proficiency in a type of work which is demanded in college and in later life.

The Falmouth Schools are provided with special supervisors of Music, Art, Physical Training, and Health. In instrumental music our work has been commended not only on the Cape but throughout the Commonwealth; in art our pupils have won many prizes and the annual exhibit attracts wide attention; in physical training all pupils receive attention and our athletic teams cherish a reputation for sportsmanship and clean playing; and in health we supplement our naturally healthy environment with expert medical advice and care. The Falmouth schools are good schools and the parents will never be satisfied with less.

THE WOODS HOLE LOG

GALE BRINGS OUT FIRE ENGINES

After a winter reported to have been unusually free from fires, the fire department at Woods Hole was stirred to unusual activity on Thursday night and Friday morning, when they were called to two fires in the vicinity.

The first one occurred at the height of a sudden storm which swept over Woods Hole about 9:30 Thursday night. This fire was caused by an incinerator which started burning on the grounds of Frank J. Mather, Jr. in Quisset. It was not serious, and was soon quenched by the prompt action of the firemen.

The second fire came early on Friday morning at Dr. Cornelia M. Clapp's cottage on Gardiner Road. This fire was started by papers left burning in the fireplace, and the sparks spread to the roof, where the fire burned a hole three feet square. Engine 2, Hose 5 and Ladder 1 were used, with Captain Ferris in charge. Dr. Clapp is Trustee Emeritus of the Marine Biological Laboratory.

According to the fire department the sudden storm on Thursday night did considerable damage; breaking the high tension wires on the Main Road which had to be repaired, and burning out the transformers opposite Cherry Valley on the Main Road. Good-sized sections of trees were reported to be lying in varied positions on the coast-side road to Falmouth, causing considerable inconvenience to autoists who were trying to flee before the storm.

THE WOODS HOLE YACHT CLUB

The Woods Hole Yacht Club plans to hold yacht races in five classes this summer. On Monday afternoons from July Fourth to Labor Day, the sailing dories, Cape Cod knockabouts, and Heweshoff Buzzards Bay knockabouts will sail over courses having their starting and finish lines near the head of Great Harbor. On Wednesday afternoons from July sixth to August thirty-first the "S" class and "Wianno Senior" class sloops will race in Vineyard Sound or in Buzzards Bay, depending on the direction of the current in the Hole in the early afternoon. Sound courses will start and end off Nobska Beach, and Bay courses off Penzance Point.

The final schedule and general announcement for the season will be issued shortly. Persons desiring information should consult the Secretary, Mr. Edward A. Norman.

SILVER BEACH

The University Players will start their fifth summer season of plays at Old Silver Beach, under the new name of "The Theatre Unit," a permanent and unified producing organization. This past winter they very successfully played in Baltimore for eighteen weeks.

The list of Plays for this season contains some very interesting and ambitious productions. The Theatre Unit has received the rights to produce three plays this summer which will appear on Broadway next year. They will open next Monday with "Magnolia" by Booth Tarkington. "Lysistrata" of Aristophanes, the Gilbert Silde's version as produced in New York and Philadelphia, and which was the high point of The Theatre Unit's Baltimore season, will be produced this summer also. It will be the largest production ever staged on the Cape, because the cast will include seventy people, exclusive of a ballet staged by Ted. Shawn.

ISLAND AIRWAYS CORPORATION

The red Bellanca seaplane which has been in the harbor so much recently has been much talked about. It has been found that this plane is capable of carrying six passengers from New Bedford to Nantucket, stopping at Woods Hole and Vineyard Haven. The first run was on Tuesday, and the pilot, Henry Olden of Fairhaven, plans to make five trips a day to and from New Bedford throughout the summer. Hand baggage is carried free by the steamship line. There are various advantages in travelling by air rather than by land or sea. The flight from Woods Hole to New Bedford takes only seventeen minutes, but this is counter-balanced by the fact that its cost is $1.25 more than the boat trip.

One of the subscribers of The Collecting Net left the following note for publication:

The Island Airways, Incorporated had a mishap on Friday but not much is known about it because the Corporation is making every effort to keep the story down. However, a connecting rod broke during the trip from Vineyard Haven to Nantucket. The Bellanca sea plane had to make a forced landing and for two hours the officials did not know where it was. Airplanes were sent to look for it. On Friday evening the airplane had been repaired and was continuing its regular schedule.

THE COLLECTING NET

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THE CORAL REEFS OF THE HAWAIIAN ISLANDS

DR. PAUL S. GALTSOFF

Biologist, U. S. Bureau of Fisheries

In 1930 the U. S. Bureau of Fisheries, in co-operation with the Navy Department who assigned the mine sweeper *Whippoorwill* to assist in biological investigation, sent an expedition for the exploration of Pearl and Hermes Reef, a small atoll situated near the western end of the Hawaiian Archipelago about 76 miles east from Midway Island and 1100 west of Honolulu. Since the discovery of Pearl and Hermes Reef in 1822 by two British whaleships which on the night of April 26 were wrecked within ten miles of each other, but a few persons visited this place. In 1858 Capt. Brooks cruising on the *U. S. S. Gambia* explored the atoll. In 1867 it was surveyed by *U. S. S. Lackawana*. Then it was visited in 1912 by a German engineer, Elschner, engaged in a study of phosphate rocks of the Pacific; and in 1923 by Dr. Wetmore of the National Museum in charge of the *Tanager* (*Continued on Page* 34)

M. B. L. Calendar

TUESDAY, JULY 5, 8:00 P. M.

Evening Seminar: Auditorium, Dr. Ethel Browne Harvey: Splitting of the Eggs of Four Neapolitan Sea Urchins by Centrifugal Force and the Development of the Halves and Quarters.

Dr. Henry J. Fry and Mr. Mark S. Parks: The Relation between Viscosity Changes and Mitotic Changes in Cleaving Eggs.

Dr. L. V. Heilbrunn: The Action of Ultra Violet Rays on the Protoplasm of Amoeba.

FRIDAY, JULY 8, 8:00 P. M.

Evening Lecture: Dr. R. W. Gerard, Associate Professor of Physiology, University of Chicago. "The Speed of Life".

FISHERY RESEARCH BY THE FEDERAL GOVERNMENT

ELMER HIGGINS

Chief, Division of Scientific Inquiry, U. S. Bureau of Fisheries

The fishery administration of the United States Government is a unique organization. Its chief functions are concerned with the conservation of our aquatic resources, yet its operations are different from those of other similar governmental units. Virtually all of the state governments maintain fishery boards, fish and game departments, or conservation commissions, all of which give direct attention to the problems of conservation through regulation of the fisheries by rule or by the enforcement of laws enacted by the state legislatures. Their functions are chiefly administrative, although a few states engage in research as a basis for their regulatory activities. Foreign governments likewise maintain fishery departments that correspond to our state commissions in their regulatory and administrative functions.

Federal activities in fishery conservation in the

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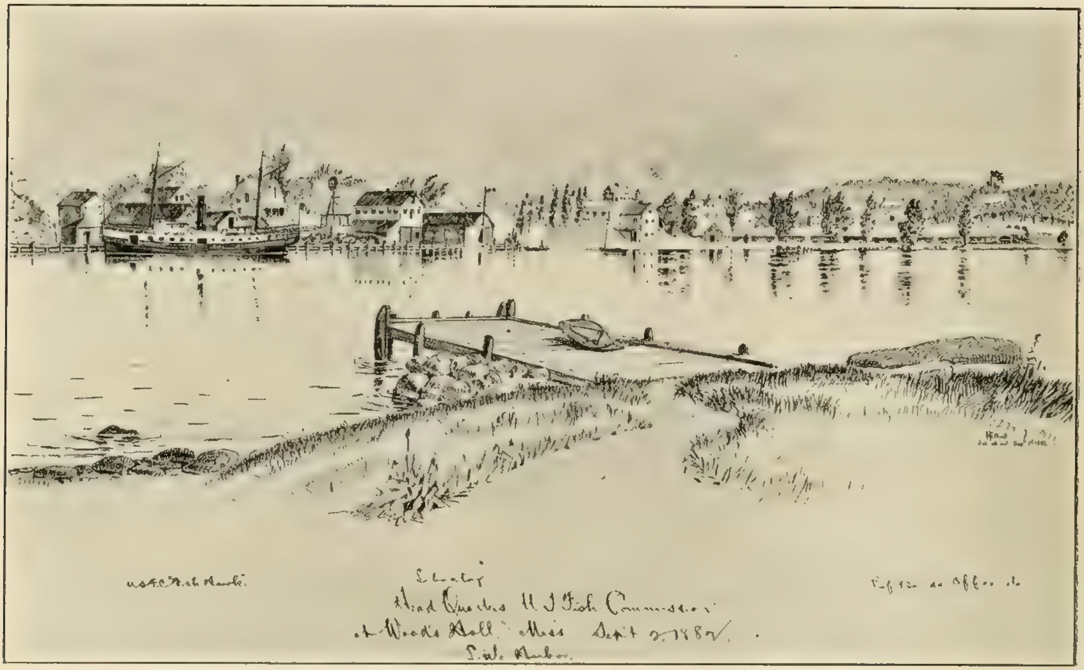


THE BUREAU OF FISHERIES STATION AT WOODS HOLE IN 1883

Professor Baird early recognized the advantages of Woods Hole as a location for marine biological research and for many years occupied temporary quarters on Little Harbor each summer until the present Fisheries Biological Laboratory and Hatchery were completed in 1883.

United States, however, are of the positive kind looking toward the development and complete utilization of aquatic resources by means of scientific research and practical fish culture, rather than by negative or restrictive activities such as are involved in the enforcement of regulatory legislation. Except in the territory of Alaska, the United States Bureau of Fisheries is without power to regulate fishing, for under the federal form of government Congress enjoys only such powers as are delegated by the Constitution, and complete jurisdiction of the fisheries has remained in the hands of the individual states. The Bureau of Fisheries is therefore essentially a scientific organization and its findings are presented to the states in the form of technical reports and direct recommendations become effective only by enactment of the state legislatures.

The research functions of the Bureau of Fisheries were defined by the Congressional resolution which established the old U. S. Fish Commission in 1871. The duties imposed upon the first Commissioner of Fisheries, Spencer F. Baird, then Assistant Secretary of the Smithsonian Institution, required him "to prosecute" the necessary inquiries, "with the view of ascertaining whether any and what diminution in the number of food fishes of the coast and lakes of the United States has taken place; and, if so, to what causes the same is due; and also whether any and what protection, prohibitory or precautionary measures should be adopted ....." The principal direction in which the bureau's functions have been expanded has been in the development of fish cultural operations begun during the second year of the Commission's existance, and in the administration of the fisheries in Alaska, including the fur seal industry, in which broad powers of regulation were conferred upon the bureau as recently as 1924.

The early attitude of the commission toward scientific work, which included the systematic investigations of the waters of the United States and the biological and physical problems which they present, was admirably expressed by G. Brown Goode in 1884 as follows: "The scientific studies of the commission are based upon a liberal and philosophical interpretation of the law. In making his original plans, the commissioner insisted that to study only the food fishes would be of little importance, and that useful conclusions must needs rest upon a broad foundation of investigations purely scientific in character. The life history of species of economic value should be understood from beginning to end, but no less requisite is it to know the histories of the animals and plants upon which they feed or upon which their food is nourished; the histories of their enemies and friends and the friends and foes of their enemies and friends, as well as the currents, temperatures, and other physical phenomena of the waters in relation to migration, reproductions and growth. A necessary accompaniment to this division is the amassing of material for research to be stored in the National and other museums for future use."

While the early years of the U. S. Fish Commission may be characterized as the era of fish-cultural development, the liberal policy with regard to scientific research resulted in the production of a rich and varied literature dealing with many phases of aquatic biology, in which surveys and explorations, with the cataloging and description of animals new to science, were most prominent. The type of biology popular during the first three decades of the commission's work is indicated by the fact that 71 per cent. of papers on the biology of fishes in the document series, were devoted to systematic ichthyology, and papers on other marine animals were almost equally devoted to taxonomy and morphology. While the fish culturists produced relatively few publications during this period, their actions spoke louder than words, for the artificial propagation of nearly every animal of economic value, vertebrate and invertebrate, was undertaken; practical inventions of all manner of apparatus, from egg trays to fishways, were perfected; and extensive efforts at transplanting and acclimatization were made, with brilliant results in some cases.

Since 1900 the policy of the bureau has undergone a gradual change. Partly because of the general trend in research in the universities throughout the country, investigators turned their interest from systematic ichthyology to the experimental branches, and papers on physiology embryology and behavior, habits, or natural history of fishes appeared in increasing numbers. Indeed, papers on the taxonomy of fishes were reduced in number from 71 per cent. to 28 per cent. of those on biology of fishes. Publications on fish propagation indicate an increasing interest in pond culture; and in the fisheries, less attention has been given to reconnaissance surveys and more to the economics and technology of the fishery industries.

This changing attitude is shown further by the interest displayed in the study of habits and behavior of fishes, which later has become expanded into studies of life history. As the publications in systematic ichthyology decreased in number, those on natural history of fishes increased, and even those papers dealing with fishery surveys have given more attention to the habits of the fishes considered.

THE U. S. BUREAU OF FISHERIES STATION AT BEAUFORT

Established by the Federal Government in 1899. It is located on a small island in Beaufort Harbor which is separated from the mainland by a channel 150 yards wide.

THE NEW FISHERIES LABORATORY AT SEATTLE

The newest Fisheries Biological Laboratory completed this year at Seattle houses the bureau's staff engaged in Pacific Coast fishery investigations and also the staff of the International Fisheries Commission, United States and Canada engaged in halibut studies.

Research activities in the biological sciences at the present time are conducted by the technical staff of the Division of Scientific Inquiry, numbering some fifty permanent research positions with a score of less trained assistants and perhaps another score of temporary specialists, chiefly from university faculties, who are employed for limited periods of time. These investigators are distributed over the entire country in small groups organized into compact research units, and maintain headquarters either at the bureau's biological or experimental stations or at universities. Only a small administrative staff in the office of the chief of the division is located at Washington, D. C. A half-dozen or so investigators whose duties require their location there are accommodated in the new laboratories of the Department of Commerce building.

The scientific projects cover three major fields: marine and fresh water commercial fisheries investigations, aquicultural investigations, and shellfisheries investigations. They are organized under seven distinct sections, each with a responsible technical head. The North Atlantic fishery investigations directed by O. E. Sette, are conducted from headquarters located at the Harvard Biological Institute, Cambridge, Mass., the Woods Hole Fisheries Biological Laboratory serving as headquarters during the summer season only. The South Atlantic staff is housed at the Fisheries Biological Laboratory, Beaufort, N. C., under the direction of Dr. H. F. Prytherch. Investigations in the Gulf, directed by Dr. F. W. Weymouth, chiefly concerned with the great shrimp fishery, are conducted from headquarters provided by the Conservation Department of Louisiana at New Orleans. Fishery investigations in interior waters, under Dr. M. M. Ellis, including studies of pollution of the Mississippi River system, are facilitated by laboratories provided by the University of Missouri at Columbia, Mo., Great Lakes fishery investigations by Dr. John Van Oosten are centered at the University of Michigan, Ann Arbor. The staff for the Pacific Coast and Alaska fishery investigations, directed by Joseph A. Craig, is housed at the new Fisheries Biological Laboratory, Seattle, Washington, which was completed during the past year and is adjacent to the campus of the University of Washington.

While the chief investigator in aquiculture, Dr.

H. S. Davis, is located in Washington, D. C., studies under his direction in the interest of fish culture, pathology of fishes, fish nutrition and selective breeding are conducted at the Fisheries Biological Laboratory, Fairport, Iowa, at the experimental trout hatchery, Pittsford, Vermont, at the experimental trout and bass station at Leetown, West Virginia, and at certain cooperation stations where facilities are provided, such as at the University of Rochester, Cornell University, the bureau's station at Cortland, New York, and its hatchery at Tishomingo, Oklahoma.

Headquarters for trout cultural investigations and stream surveys conducted by Dr. A. S. Hazzard in the national parks and forests of the Rocky Mountain region are maintained at the University of Utah, Salt Lake City, while California trout investigations carried on by Dr. Paul R. Needham are centered at Stanford University.

The chief oyster investigator, Dr. Paul S. Galtsoff, is also located in Washington, but field laboratories have been established at Yale University and at Milford, Connecticut. A cooperative laboratory for oyster research on Puget Sound is furnished by the State of Washington at Olympia.

During the past year the division has operated a number of vessels, launches, and floating laboratories in the conduct of its scientific investigations. Various phases of the North Atlantic fisheries investigations have required the full time of the *Albatross II.*, a 150-foot sea-going steam vessel equipped for oceanographic work and experimental trawling. The *Phalarope*, a 110-foot steam yacht, and a chartered power boat in New Jersey, have also been employed part time. Fishery studies in Lake Michigan have been prosecuted from the motor ship, *Fulmar*, a 102-foot vessel equipped for experimental fishing and limnological studies. An able 38-foot cabin motor cruiser and various smaller launches are stationed at the Beaufort (N. C.) laboratory and two sea going launches 45 and 65 feet respectively, are used by the shrimp investigators of the Gulf. On the Mississippi River two house boats and various launches provide laboratory and collecting facilities, one an 85-foot Quarter Boat on the lower river houses Dr. Ellis' staff of a dozen co-workers and has a large, well-equipped physiological and chemical laboratory, and another 50 feet long is stationed in the Upper Mississippi Wild Life and Fish Refuge for limnological work. In Alaska a 45-foot launch is used exclusively for herring investigations and various others of the bureau's large fleet of vessels are employed as circumstances warrant. The biological stations are all equipped with adequate launches and rowboats. During the last two years the bureau's 85-foot motor ship *Pelican* has been used in scientific investigations by the International Passamaquoddy Fishery Commission.

The marine fishes of the Atlantic and Pacific coasts support a tremendous food industry. No longer are new fishing grounds being discovered as in former years, but the exploitation of the more productive grounds has increased rapidly during the past decade. Hence, the outstanding problem of these fisheries receiving first attention by the division of inquiry is that of proper husbanding of the supply in order that the resource may be utilized to the fullest extent compatible with its maintenance in a state of maximum productivity. In the North Atlantic area, the fisheries are being critically studied to discover at the earliest moment signs of depletion from overfishing, and the factors that govern fish reproduction are being examined so that advance information regarding fluctuations in abundance may be made available to the industry. On the Pacific Coast inquiries of a similar sort are being prosecuted, and in the Alaska fisheries the results of such investigations find immediate application in the drafting of fishery regulations imposed by the Federal Government. Fisheries in the interior waters, aside from those in the Great Lakes are prosecuted primarily for sport and recreation. The tremendous increase in the army of anglers, coupled with industrialization and resulting stream pollution in the eastern half of the country have placed an intolerable strain upon the fish supply; and investigations are therefore directed toward the intelligent restocking of depleted waters, toward the perfection of fish cultural methods for such purposes, and toward overcoming the pollution menace. The shellfish resources of our coast line have been an important food resource since earliest times, and recent researches as to their dietary values enhance rather than detract from their importance as a healthful food. Unrestrained harvesting of the natural supply has led to marked depletion in many areas, and the view is rapidly gaining popular acceptance that the adoption of modern methods of farming of oysters, clams, and other mollusks, either by private initiative or through rigid state regulation, is the only practicable means of restoring the productivity of our shellfish beds. The bureau investigations are, therefore, directed to that end with gratifying results that appear to be fully appreciated by the fishing industry. Minor problems of research conducted by the division all tend toward the solution of these practical problems of the fisheries. The period of exploration and description reached its height during the last century and has passed. More modern methods of experimental biological and statistical analysis have taken its place, and fisheries research is rapidly assuming the form and content of an exact science.

THE CORAL REEFS OF THE HAWAIIAN ISLANDS

(Continued from Page 29)

expedition. In 1927 extensive pearl oyster beds discovered on the reefs of the lagoon, attracted fishermen and pearl oyster divers from Honolulu and Japan. With the exception of one case small fishing boats (sampans) were either lost at sea or having failed to reach their destination were forced to return home. Intensive shelling operations were carried on, however, by one company who dispatched a schooner to Pearl and Hermes and on one of the islands erected several buildings which served as comfortable headquarters for our expedition.

The Pearl and Hermes lagoon is an atoll about eighteen miles long and twelve miles wide. It is partially surrounded by a narrow strip of coral reefs which embrace it on the East, South and Southwest leaving the northern and northwestern sides unprotected.

A series of islands, most of them merely sand bars, extends from the northwestern corner along the eastern and southern sides of the lagoon. The lagoon itself comprises a maze of small reefs and channels, with the depth of water varying from a few inches to 104 feet. The reefs growing inside the lagoon are made up by finger like corals *Porites compressa, P. lobata* and a number of other species: *Pocillopora damicornis, P. lingulata; Montopora verrucosa, M. verilli; Pavona varians* and *P. duerdeni; Cyphastrea ocellina; Dendrophyllia manni;* and *Fungia scutaria*. The predominant forms, primarily responsible for the building up and maintenance of the encircling reef belong to the species of Porites and Pocillopora the colonies of which are strongly reinforced by the luxuriant growth of numerous nullipores. The rôle of these algae in building up reefs is probably equal if not superior to that of the corals.

Between the coral reefs the bottom of the lagoon is covered with shifting sand which at the depth of about fifty feet, and below, is replaced by soft and sticky coral mud. Configuration, depth and distribution of reefs, sand and mud, reflect the prevailing physical conditions and can be easily understood if one realizes that the present features of Pearl and Hermes, which in many respects can be regarded as a typical atoll, are determined both by the constructive forces of the reef builders and destructive action of waves, breakers, wind, rain, and various organisms, contrary to Darwin's well known conception of atoll formation, which implies a gradual subsidence of the foundation and filling up of the lagoon with sediments, there are numerous indications that the material forming the floor of the lagoon is constantly being washed away and deposited at a greater depth outside the encircling reef. A comparison between the charts prepared in 1867 and in 1930 show noticeable increase in the area of the lagoon especially at its southeastern corner. An important rôle in the destruction of coarse material of the lagoon floor and its reduction into fine mud is attributable to a large black bêche-de-mer, *Holothuria atra,* an organism measuring over a foot in length and weighing several pounds. Millions of these sluggish animals are found everywhere on the bottom, being especially conspicuous on the white background of the sandy shoals. Experiments with related forms made in the atolls of the Indian Ocean and in Japan show that the intestines of the bêche-de-mer of that size may contain as much as 88 grams of sand and that about half of that amount is ingested daily and passed through the intestinal tract. Presumably the material is not dissolved, for the contents of the guts are not acidified, but is simply triturated into fine sand, which passes through a 0.5 mm. sieve, and mud. Similar action is exercised by a number of worms and sea urchins.

The echinoderms of Pearl and Hermes are represented by the beautiful red slate-pencil sea urchin, *Heterocentrosus mamillatus,* very common in the Hawaiian Islands, and black long-spined *Echinotrix calamaris*. The latter species is distinctly a nocturnal organism. Incredible numbers of it can be found every night in the shallow water along the beaches where they nearly completely cover the bottom with their spiny bodies. During the day only a few specimens can be found under the rocks.

The starfishes are not abundant. The most common species is small *Lyncia multipora*. The soft skinned sunflower starfish, *Acanthaster planci,* is quite common while the huge red *Luidia magnificia,* measuring 33 inches in diameter can be found only at a depth of about twenty to forty feet. Of the large number of molluscs, mention should be made of the cowry shell, *Cytherea sulcidentata,* an endemic Hawaiian species; cones, *Conus litteratus,* with large and heavy shells covered in July and August with leathery egg capsules; *Spondylus tenebrosus, Arca ventricosa,* and huge conch, *Cymation tritonus* reaching about 14 inches in length. Long and beautifully shaped *Terebra maculata* are found exclusively on sandy bottom in which they make long burrows extending for fifty or sixty feet, indicating the presence of the animal at one of the ends of the long trail.

Among the lamellibranchs the most conspicuous place belongs to the pearl oyster, *Pinctada galtsoffi,* which slightly differs from the closely related species, *P. margaritifera* and *maxima* of the Phillippines and Australia. The shells of the Hawaiian pearl oyster reach a large size and are heavy. Specimens 25 - 30 cms. long and weighing several pounds are common. The largest oyster obtained in 1928 weighed fifteen pounds. According to the studies made by the author the weight-length relationship of the shell of this mollusc can be expressed by the equation $W=0.042\ L^{3.21}$, where W is weight in grams and L is length in centimeters.

Of the oysters examined during the expedition, approximately ten per cent. contained pearls of different qualities.

About 300 live pearl oysters were taken on board the *Whippoorwill,* placed in wooden tanks supplied with running sea water, and were safely transported to Honolulu where they were planted in Kaneohe Bay.

It has been found that the pearl beds in the atoll had suffered considerably from unrestricted fishing during the previous two years. If left unprotected they undoubtedly would be completely wiped out in a short time.

Spawning of the pearl oyster occurs at a temperature of about 27°C, similar to the conditions existing in edible oysters, the discharge of the sexual products can be induced by the addition of sperm or eggs. Analysis of a few temperature records available for this unexplored part of the Pacific support the conclusion that spawning occurs only once a year.

The crustacean fauna of the lagoon is very rich. Of special interest to the biologist are the large hermit crabs, *Dardanus sanguinolatus, D. deformis,* living in the shells of *Tonna melanostoma,* and the small crab, *Haplocarcinus marsupialis,* which causes the formation of galls in corals (Pocillopora).

The lagoon abounds in fish, sea turtles and seals. Several small and uninhabited islands formed of broken corals and sand are covered with scanty vegetation, the grass *Eragrostis variabilis* being the predominant plant. Since there is no fresh water one is entirely dependent on rain or on the supply brought along from the ship.

During the severe storms which occur quite often the islands are swept by huge waves that break over the encircling reefs.

All the islands are inhabited by large and noisy colonies of birds (albatrosses,, boobies, tail-wedged shearwaters, sooty terns, frigates and others) which since 1909 have been placed under the protection of the U. S. government.

THE COURSE IN ALGAE AT THE MARINE BIOLOGICAL LABORATORY

Dr. William Randolph Taylor

Professor of Botany, University of Michigan Director of the Course.

Three current lines of research activity are kept in mind in organizing the course in study of Algae as conducted at the Marine Biological Laboratory. In the first place, the systematics of the major groups have been subjected to a complete rearrangement in recent years as a result of discoveries revealing unsuspected phases in the life cycle, or in other cases from fundamental differences in structure and physiology. There are now about twelve major groups of algae recognized instead of four to six at the beginning of the century, and such a changed view of their relations has developed as to give a much more accurate, though perhaps more complicated conception of their evolutionary relations. In the second place, active physiological work on algae requires more thorough knowledge of their cell structure and more accurate ideas of their specific limitations. Again, interest in fisheries research and conservation of lakes calls for knowledge of the factors in control of periodic development of floras and of algal distribution.

On a framework of observations upon algal anatomy and reproduction with the groups treated in approximate systematic sequence, the course attempts to support sufficient excursions into systematic literature to acquaint the student with the necessary approach to an accurate taxonomic allocation of his material, a modern discussion of the cytological basis upon which life-history studies are interpreted, the more striking physiological peculiarities of the several great groups, and with the field work an introduction to algal ecology and distribution. Since this course cannot assume any detailed knowledge of algae on the part of the students the treatment of these topics while strictly technical, must be rather elementary. However, in order that algal or other research may be forwarded during the course, time is reserved for conferences each week with those who are continuing or initiating investigations based upon Woods Hole material, and for those whose progress justifies it, arrangements can be made to further the work after the close of the formal part of the course.

The Collecting Net

A weekly publication devoted to the scientific work at Woods Hole.

WOODS HOLE, MASS.

Ware Cattell .... Editor

Assistant Editors

Florence L. Spooner Annaleida S. Cattell

Vera Warbasse

Beach Restrictions

I

About a year ago a senior investigator—who is a trustee of the Marine Biological Laboratory—wrote the following statement for publication in The Collecting Net:

"Two recent cases of the assertion of property rights, the limitation of the bathing space on the bayside beach and the courteously formulated request of the Trustees of the Forbes estate, call the attention of the scientific institutions in Woods Hole to the need of safeguarding and developing recreational facilities.

"It is natural and desirable that laboratory workers should hope to profit from the physical advantages of their environment. It is certainly true that some investigators, even among those who have acquired property, are beginning to feel that Woods Hole is likely to become less desirable for themselves and their families unless recreational facilities can be retained and expanded. Is there, for example, any surety that the bathing beach frontage may not be limited to that of a single lot or even lost entirely if efforts are not made to place the bathing beach under public or institutional control? The Marine Biological Laboratory has shown foresight in providing real estate for the summer homes of investigators and it now seems desirable that attention should be paid to these recreational needs before it is too late."

The lapse of a year's time has shown no improvement in the situation, and his statement is perhaps even more pertinent now than it was in 1931.

A group of interested individuals is forming a committee to study the question of bathing facilities in all of its aspects. Two or three influential investigators have already consented to serve on it. The Collecting Net is contributing $50.00 to assist the committee and it is expected that this sum will be promptly doubled by contributions from other sources. No specific plans for spending the money have been formulated, but it is realized that a committee with money will be more effective than one without.

The New Seaplane Service

It is supposed to be poor policy to mention names of commercial enterprises in an editorial column, but we make an exception in this note because our relations with the Island Airways, Inc. are going to be of real assistance to The Collecting Net. This summer we will be under continuous obligations to them for they have consented to convey copy, blocks and proof two or three times a day between Woods Hole and New Bedford. The Darwin Press is only four short blocks from their landing dock at the latter port, and the time taken to transfer material from our office to the Press is only twenty-five minutes.

Yesterday, two members of our staff flew in one of the sea planes to and from New Bedford. The trip was comfortable and quick. It took seventeen minutes, which made the trip an hour shorter than it would have been by land or seea.

VICTROLA CONCERT PROGRAM

Wednesday, July 6

(1) Midsummer Night's Dream Overture — *Mendellsohn*

(2) Symphony No. 39 — *Mozart*

Intermission

(3) Symphony in D Minor — *Franck*

The following evening lectures were scheduled for the last of June and the first of July at the Cold Spring Harbor Biological Laboratory.

June 21 Prof. W. W. Swingle, "Experimental Studies on the Adrenal Cortical Hormone".

June 28, Prof. Robert W. Chambers, "The Physical Nature of the Cell and Some Phases of its Semipermeability".

June 30, Dr. Charles B. Davenport, "Our Fleet".

July 5, Dr. Hugo Fricke, "The Place of Physics in Modern Biological Research".

Dr. A. A. Schaeffer, who was in residence at the Laboratory during much of the winter, and who is continuing his work here this summer, has been appointed Chairman of the Department of Biology at Temple University.

The freak storm which struck Woods Hole last Thursday night with such surprising force, did many strange things. It is said a Manchester sloop broke loose and headed merrily in its freedom for Nantucket. Furniture was badly tossed about on peoples' porches. A white yawl let go of its mooring to plow into the Acushnet to see how much white paint could be taken off. The best story of all, whether true or not, is that a car on the Buzzards Bay bridge was blown quite off. One sedan went through the railing and off, not into the water, fortunately, because the water was not up that far, but onto hard, dry land.

ITEMS OF INTEREST

Dr. and Mrs. L. T. Woodruff have purchased property in Gansett Woods, where they expect to make a permanent home. They and their family have been coming to Woods Hole for five or six years, but have only rented their houses up to this time. The house will be ready for occupancy some time this month. Their son, Lorry, is now a member of the crew of the schooner "Discovery," which is taking part in the Bermuda race.

Dr. Robert Chambers has left Woods Hole for a short time for a visit to Cold Spring Harbor, where he will deliver some lectures.

Dr. and Mrs. Potter moved into the Gigger's cottage last Thursday.

Mr. Nathan Calkins had his first solo flight this week at the Falmouth Airport, and since then he has flown every day.

Mr. Arthur Meigs has left this week for Europe with a classmate from Princeton. They intend to wander around Germany with no set itinerary, then they are going to Geneva and Lausanne, where they will observe the disarmament conferences which are being held at this time.

Miss Margaret Riggs is leaving for Europe this summer, and will return in time to enter Bryn Mawr as a sophomore in the Fall.

THE SCIENCE SCHOOL

At the Annual Meeting of the Association of The Children's School of Science, which was held on Friday, June 24, the following officers for the ensuing year were elected:

President .... Mrs. Compton
Vice President...................... Mrs. Edwards
Secretary .... Mrs. Bigelow
Treasurer .... Mrs. Gigler

A VACATION CLUB

Although it may seem that the summer residents are here only for a vacation, a club has been found to have existed for almost twenty years, which is devoted to the discussion of current problems and the reading of new books. The members are all the original charter members, and have met together every Wednesday afternoon at each other's homes from year to year.

The members of this club are Mrs. Wilfred Wheeler, Mrs. Frank Lillie, Mrs. Ralph Lillie, Mrs. Gary N. Calkins, Mrs. Laurence Riggs, Mrs. Edward Wilson, Mrs. George Clowes, Mrs. Edward Meigs, Mrs. James P. Warbasse. This Wednesday they will discuss Stuart Chase's "Mexico".

The first Sunday Forum will be held at 4:00 P. M. at Penzance Point at "Gladheim", the residence of Dr. and Mrs. J. P. Warbasse, on Sunday, July 3. All are invited, and whoever comes might find it the better part of wisdom to bring a blanket to sit on.

BASEBALL AT WOODS HOLE

Filling a long-felt want for several years, some of the more actively baseball-minded in the laboratories have revived the Great American sport this season. To date, two teams have been organized and four games played. All who are interested are cordially invited to be present at the Town Park evenings after supper or other times, as posted.

So far, the rivalry has been between two teams, one made up of independent investigators and the other drawn from students, waiters and janitors. Sunday morning saw the "K. P.s" take the "P.h. (?) Ds" into camp, 8 to 5 behind the pitching of Dan Campbell. Monday evening the two teams split a double-header, the P.h. Ds winning the opener, 12 to 4 and the K. P.s coming back in the night-cap (so called on account of darkness after seven innings) to win 7 to 1. On Tuesday evening, the K.Ps took a closely contested game by the score of 8 to 7. The K. P. team comprises the following men: Campbell, Nicoll, Eastlick, Walker, Rundles, Curry, Coombs, Porteous, Morris, Kohn and McManus. Among the Ph. d. (?) players are Heilbrunn, Coonfield, Dee, Stabler, Crampton, Butt, Aiken, Barth, Mazia, Fuchs and others.

With as good a beginning as this, it is felt that much interest has already been aroused. The present aim is to arrange a definite schedule of games, with notices posted a day or so in advance on the bulletin board at the Mess. The more spectators, the better the baseball, and every day is Ladies' Day at Woods Hole. It has been suggested that more teams be organized, perhaps with the formation of two leagues with a "World's Series" at the close of the summer. Also, a need is felt for men who would be willing to umpire the games, and a special plea is made that if any feel so moved, they may come down or get in touch with Dr. Heilbrunn, Dr. Stabler or Mr. Nicoll. Any suggestions towards improving the sport will be more than welcome. It is to be remembered that baseball, the neglected sport of Woods Hole, is the game of games, and that, unlike tennis and horse-shoe pitching, it may be played and watched even with the Depression Pocketbook.

Pocketbook. —*Two Baseball Players.*

DIRECTORY FOR 1932

KEY

Laboratories		Residence	
Botany Building	Bot	Apartment	A
Brick Building	Br	Dormitory	D
Lecture Hall	L	Drew House	Dr
Main Room in Fisheries Laboratory	M	Fisheries Residence	F
Old Main Building	OM	Homestead	Ho
Rockefeller Bldg.	Rock	Hubbard	H
		Kahler	Ka
		Kidder	K
		Whitman	W

In the case of those individuals not living on laboratory property, the name of the landlord and the street are given. In the case of individuals living outside of Woods Hole, the place of residence is given in parentheses.

MARINE BIOLOGICAL LABORATORY

INVESTIGATORS

Amberson, W. R. prof. phys. Tennessee. Br 309. D 111.
Armstrong, P. B. asst. prof. anat. Cornell Med. Br 318. A 106.
Baitsell, G. A. prof. biol. Yale. Br 323. Brooks.
Baker, H. B. assoc. prof. zool. Pennsylvania. Br 221.
Bard, P. asst. prof. phys. Harvard Med. Br 109. D 306.
Barth, L. G. instr. expt. emb. Columbia. Br 111. D 206.
Beck, L. V. asst. phys. Pittsburgh. Rock 2. McLeish, Millfield.
Bowling, Rachel instr. proto. Columbia. OM 21. A 307.
Boyden, Louise E. edit. asst. "Biol. Bul." Br 305. Young, West.
Boyer, D. A. instr. biol. Chicago. Br 353. McLeish, Millfield.
Brinley, F. J. asst. prof. zool. North Dakota State. OM 39. D 102.
Brooks, Matilda M. res. assoc. biol. California. Br 233. Gosnold.
Brooks, S. C. prof. physico-chem. biol. California. Br 306. Gosnold.
Buchsbaum, R. M. instr. biol. Chicago. Br 343. McLeish, Millfield.
Burr, Edith R. asst. zool. Barnard. Br 314. K 3.
Butt, C. res. asst. phys. Princeton. Br 116. White, Millfield.
Cable, R. M. grad. asst. biol. New York. OM Base. K 7.
Calkins, G. N. prof. proto. Columbia. Br 331. Buzzards Bay.
Campbell, D. H. grad. asst. biol. Washington. Br 225. Dr attic.
Carothers, Eleanor lect. zool. Pennsylvania. Br 221. A 204.
Castle, W. A. instr. biol. Brown. OM 3. Kittila, Bar Neck.
Cattell, W. assoc. ed. "Scientific Mo." Br 344. A 102.
Chambers, R. res. prof. biol. New York. Br 328. Gosnold.
Chidester, F. E. prof. zool. West Virginia. Br 344. D 318.
Child, G. P. asst. instr. biol. New York. Br 1. A 108.
Chute, A. L. asst. phys. Toronto. phys. D 107.
Clark, Frances secretary. Br 328. Howes, Main.
Clowes, G. H. A. dir. Lilly Res. Labs. Br 328. Shore.
Coe, W. R. prof. biol. Yale. Br 323. A 201.
Cohen, Rose S. grad. asst. zool. Cincinnati. L 29. H 6.
Cole, K. S. asst. prof. phys. Columbia. Br 343. D 216.
Coonfield, B. R. instr. biol. Brooklyn, OM 29. McLeish, Millfield.
Costello, D. P. instr. zool. Pennsylvania. Br 217n. Elliot Center.
Cowles, R. P. prof. zool. Hopkins. Br 340. D 315.
Crampton, Clair B. res. asst. biol. Wesleyan. Br 210. K 5.
Croasdale, Hannah T. asst. bot. Pennsylvania. Bot. 23. H 9.
Crummy, P. L. grad. asst. zool. Pittsburgh. Rock 7. McLeish, Millfield.
Dan, K. grad phys. Pennsylvania. Br 110. Eldridge, Main.
Darlington, C. D. cytologist. John Innes Hort. Inst. (London). Br 122 A. McLeish, Millfield.
Doyle, W. L. res. asst. zool. Hopkins. Br 329. Dr 6.
Dunn, E. E. grad. biochem. Cincinnati. Med. Br 342. McLeish, Millfield.
Duryee, W. R. instr. zool. Northwestern (Illinois) OM 4. D101b.
Edwards, D. J. assoc. prof. phys. Cornell. Br 214. Gosnold.
Fish, H. S. grad. biol. Harvard. Br 315. Dr 1.
Fry, H. J. prof. biol. New York. OM Base. Purdum, Woods Hole.
Garrey, W. E. prof. phys. Vanderbilt Med. Br 215. Gardiner.
Gerard, R. W. assoc. prof. phys. Chicago. Br 309. D 313.
Glaser, R. W. assoc. mem. Rockefeller Inst. Br 208.
Goldforb, A. J. prof. biol. Col. City N. Y. Br 122c. A 302.
Goodrich, H. B. prof. biol. Wesleyan. Br 210. D 110.
Goodson, Mary L. Barnard. Br 344. A 102.
Grave, B. H. prof. zool. DePauw. Br 234. Grave, High.
Grave, C. prof. zool. Washington (St. Louis). Br 327. High.
Guerlac, H. E. asst. phys. Cornell. OM 5. Cowey, Quissett.
Hahnert, W. F. Nat. Res. fel. biol. Hopkins. Br 111. Ka 21.
Harnly, Marie L. asst. biol. New York. Br 1. D 202.
Harnly, M. H. asst. prof. biol. New York. Br 1. D 202.
Harryman, Ilene res. asst. chem. Lilly Res. Labs. Br 319. D 103.
Harvey, Ethel B. independ. invest. phys. Princeton. Br 116. Gosnold.
Harvey, E. N. prof. phys. Princeton. Br 116. Gosnold.
Heilbrunn, L. V. assoc. prof. zool. Pennsylvania. Br 221. Schramm, Gardiner.
Hill, E. S. res. asst. phys. chem. Rockefeller Inst. Br 206. D 316.
Hill, S. E. asst. gen. phys. Rockefeller Inst. Br 209. Veeder, West.
Hook, Sabra J. asst. prof. biol. Rochester. Br 217a. K 2.
Hoppe, Ella N. res. asst. biol. N. Y. State Dept. Health. Br 122B. A 207.
Huettner, A. F. prof. biol. New York. Br 228. Gansett.
Irving, L. assoc. prof. phys. Toronto. Br 109. Amberson. Quissett.

Jackson, J. R. grad. asst. biol. Missouri. Bot 1st Floor. K 10.
Jenkins, G. B. prof. anat. George Washington. Br 33. Cannan, Gardiner.
Johlin, J. M. assoc. prof. biochem. Vanderbilt Med. Br. 336. Park.
Kaliss, N. grad. zool. Columbia. Br 314. McLiesh, Millfield.
Keil, Elsa M. instr. zool. N. J. Col. for Women. Br 8. W d.
Keltch, Anna K. res. chem. Lilly Res. Labs. Br 319. Duff, Millfield.
Keosian, J. asst. biol. New York. Br 339. A 108.
Kidder, tutor biol. Col. City N. Y. Br 314. D 307.
Kinney, Elizabeth T. lect. zool. Barnard. Br 217b. K 3.
Kirkpatrick, T. B. assoc. prof. physical education. Columbia. L 26. Nickerson, Milfield.
Knower, H. McE. assoc. prof. anat. Albany Med. Br 234. Buzzards Bay.
Knowlton, F. P. prof. phys. Syracuse Med. Br 226. Gardiner.
Kohn, grad. zool. Yale. OM 43. K 6.
Krieg, W. J. S. instr. anat. New York. OM 34. Elliot, Center.
Lackey, J. B. prof. biol. Southwestern (Memphis). Br 8. A 203.
Lancefield, D. E. assoc. prof. zool. Columbia. Br 333 A.
Lancefield, Rebecca C. asst. bact. Rockefeller Hosp. (N. Y.) Br 208.
Landowne, M. fel. biol. Col. City N. Y. Br 122c. Ka 22.
Lawlor, J. T. fel. bot. Harvard. bot. Cowey, School.
Laug, E. P. instr. phys. Pennsylvania. Br 8. D 302.
Lillie, F. R. prof. zool. Chicago, Br. 101. Gardiner.
Lillie, R. S. prof. gen. phys. Chicago. Br 326. Gardiner.
Lynch, Ruth S. instr. genetics. Hopkins. Br 127. D 201A.
Magruder, S. R. grad. asst. zool. Cincinnati. L 29. Kittila, Bar Neck.
Marsland, D. A. asst. prof. biol. New York. Br. 339. D 106.
Mast, S. O. prof. zool. Hopkins. Br 329a. Minot.
Mathews, A. P. prof. biochem. Cincinnati. Br 342. Buzzards Bay.
Mazia, D. Pennsylvania. Br 221. Ka 23.
McGoun, R. C., Jr. instr. biol. Amherst. Br 204 Dr.
Michaelis, Eva M. res. asst. phys. Columbia. Br. 114. Gansett.
Michaelis, L. mem. Rockefeller Inst. Br 207. Gansett.
Miller, F. W. grad. asst. zool. Pittsburgh. Rock 7. K 15.
Miller, F. W. res. worker zool. Pittsburgh. Rock. K 15.
Mills, Sylvia M. res. fel. zool. Radcliffe. Br 213.
Milton, L. instr. chem. New York. Br 310. Wilson, Buzzards Bay.
Moreland, F. B. fel. chem. Rice Inst. (Texas). Br 336. Dr 1.
Nelson, E. C. asst. biol. Hopkins. OM Base.
Nicoll, P. A. grad. asst. zool. Washington (St. Louis). Br 225. Dr 2.
Nonidez, J. F. asst. prof. anat. Cornell Med. Br 318. Whitman.
Orias, O. Rockefeller Foundation. Br 108. A 208.
Pace, D. M. res. asst. phys. Hopkins. Br 329. Russell, (Bourne).
Packard, C. asst. prof. zool. Columbia Inst. Cancer. OM 2. North.
Parker, G. H. prof. zool. Harvard. Br 213. A 104.
Plough, H. H. prof. biol. Amherst. Br 204. Whitman.
Pollister, A. W. instr. zool. Columbia. OM 44. D 314.
Pollister, Priscilla F. instr. biol. Brooklyn. OM 44. D 314.
Pomerat, C. M. instr. biol. Clark. Higgins, Depot.
Pond, S. E. prof. phys. Pennsylvania Med. Br 216, Gansett.
Poole, J. P. prof. evolution. Dartmouth. Bot 25. D 305.
Porter, Helen tech. zool. Harvard. Br 213. Grinnell, Bar Neck.
Prescott, G. W. asst. prof. bot. Albion. Bot 22. D 107.
Prosser, C. L. fel. zool. Harvard Med. Br 109. Dr 6.
Richards, O. W. instr. biol. Yale. Br 8. A 303.
Robert, Nan L. instr. zool. Hunter. Br 217. A 206.
Robertson, Lola tech. zool. New York. OM Base. Haven, Main.
Robertson, C. W. asst. Biol. New York. OM Base. Haven, Main.
Root, W. S. assoc. prof. phys. Syracuse Med. Br 226. Erdwurm, High.
Rugh, R. instr. biol Hunter. Br 111. D 308.
Sanger, G. Cornell Med. Br 214. Edwards, Gosnold.
Schechter, V. grad. biol. Columbia. Br 122 C. Dr 2.
Schmidt, L. H. res. fel. biochem. Cincinnati Med. Br 341. McLeish, Millfield.
Scott, A. C. asst. zool. Columbia. Br 314. Rosear, East.
Scott, Florence M. asst. prof. zool. Seton Hill. Nickerson, Millfield.
Sell, J. P. grad. asst. biol. Yale. OM 43. K 6.
Sichel, F. J. M. asst. biol. New York. Br 338. Dr 2.
Silvey, J. K. G. instr zool. Michigan. OM J. Ka 4.
Smith, E. L. grad. zool. Columbia. Br 314. Dr 34.
Sonneborn, T. M. res. assoc. zool. Hopkins. Br 127. D 201.
Southwick, W. E. fel. zool. Harvard. Br 315. Lyons, Main.
Speicher, B. R. grad. asst. zool. Pittsburgh. Rock 7. K 15.
Speidel, C. C. prof. anat. Virginia. Br 106. D 104.
Stabler, R. M. instr. zool. Pennsylvania. OM 22. Whiting, Minot.
Starkey, W. F. grad. zool. Pittsburgh. Rock 7. Dr attic.
Stewart, Dorothy R. asst. prof. biol. Skidmore. Br 232. D 105.
Stockard, C. R. prof. anat. Cornell Med. Br 317. Buzzards Bay.
Street, Sibyl grad. zool. Chicago. Br 8. McLeish, Millfield.
Sturtevant, A. S. H. prof. genetics. California Inst. Tech. Br. 332. Agassiz.
Sumwalt, Margaret asst. instr. phys. Pennsylvania Med. Br 232. D 105.
Tang, P. S. instr. gen. phys. Harvard. Br 309. D 305.
Tashiro, S. prof. biochem. Cincinnati. Br 341. Park.
Taylor, J. W. Nat. Res. fel. phys. Princeton. Br 116. Cowey, School.
Taylor, G. W. Nat. Res. fel. phys. Princeton. Br 116.
Titus, C. P. dir. Sch. Microscopy (N. Y.) OM Base. D 213.
Townsend, Grace fel. zool. Chicago. Br 217i. W b.
Wade, Lucille W. asst. Lilly Res. Labs. Br 319. Robinson, Quissett.
Walker, P. A. grad. asst. phys. Harvard. Br 312. Thompson, Water.
Weisman, M. N. grad. biol. Columbia. Br 314. Dr 14.
Wilson, E. B. DaCosta prof. emeritus zool. Columbia. Br 322. Buzzards Bay.
Wilson, Hildegard N. fel. biochem. Bellevue Med. Br 310. Buzzards Bay.

Te Winkel, Lois E. grad. zool. Columbia. Br 314. K 2.
Winokur, M. fel. biol. Col. City N. Y. OM Base. Ka 2.
Wolf, E. A. assoc. prof. zool. Pittsburgh. OM 43. Elliot, Center.
Young, Roger A. asst. prof. zool. Howard. Br 110. A 301.
Young, S. B. tech. Rockefeller Inst. Br 209. Young, Middle.
Zeleny, C. prof. zool. Illinois. Br 122D. D 301.
Zirkle, C. assoc. prof. bot. Pennsylvania. Bot 6. Boss, West.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

INVESTIGATORS

Alexander A. E. minerologist and petrographer. Harvard. 212. Thomas, Buzzards Bay.
Beach, E. F. Brown. 109. Hilton, Main.
Bigelow, H. B. prof. zool. Curator of Oceanography. Harvard. 114. Luscombe, Main.
Brown, F. A., Jr. fel. zool. Harvard. 315. Hilton, Millfield.
Harwood, E. M. grad. zool. Clark. 206 Wilde, Gardiner.
Hines, J. M. Brown. 211. Stuart, School.
Ingalls, Elizabeth N. tech. Harvard. 103. Young, West.
Lutz, F. B. Brown. 111. Hilton, Water.
Mitchell, P. H. prof. phys. Brown. Mitchell, Orchard.
Rakestraw, N. W. assoc. prof. chem. Brown. 109. Mitchell, Orchard.
Renn, C. E. asst. biol. New York. 201. Young, Middle.
Reuszer, H. W. instr. biol. Rutgers. 201. Young, Middle.
Root, Raymond W. instr. biol. Col. City N. Y. 101. Young, West.
Schroeder, W. C. business manager. 113.
Walker, Virginia B. asst. business manager. 112. Howes, Millfield.
Welsh, J. H. instr. zool. Harvard. 213. McInnis, Millfield.
Whitman, C. F. geologist. Radcliffe. 212. Kittler, Bar Neck.
Wolfe, Mary F. grad. biol. Radcliffe. 212. Kittila, Bar Neck.

U. S. BUREAU OF FISHERIES

Galtsoff, Eugenia assoc. zool. George Washington. 122. F 26.
Galtsoff, P. S. biol. U. S. B. F. (Washington) 122. F 26.
Linton, E. fel. parasitology. Pennsylvania. M 5. West.
Worley, L. G. asst. zool. Harvard. Hatchery. F 37.

STUDENTS

Aiken, R. B. res. fel. Vermont. Emb. K 7.
Bach, Doris A. Michigan. bot.
Belcher, Jane C. grad. Colby. emb. H 3.
Beltran, E. prof. zool. Mexico. proto. D 203.
Bingham, N. E. grad. zool. proto. Sylvia, Buzzards Bay.
Bridges, J. C. instr. biol. Michigan. phys. A 106.
Brown, Rebecca Goucher. proto. H.
Brubaker, Ethel instr. biol. Pennsylvania. bot. Stokey, Gardiner.
Burrows, R. B., Jr. grad. asst. biol. Yale. emb. Ka 2.
Butler, T. C. Vanderbilt Med. phys. Pond, Gansett.
Chao, I. grad. phys. Chicago. phys. D 217.
Coplan, Helen M. asst. biol. Goucher. phys. H 2.
Craig, F. N. grad. phys. Rutgers. phys. Ka 24.
Cowles, Janet M. Hopkins. emb. D 315.
Cummings, Frances Albertus Magnus. emb. Broderick, South.
Dieter, C. D. asst. prof. biol. Washington and Jefferson. emb. Howes, Water.
Duncan, P. M. grad. zool. Pennsylvania. proto. Dr attic.
Earl, Ruth R. grad. biol. New York. proto. W f.
Eastlick, H. L. grad. asst. zool. Washington (St. Louis). emb. Dr 2.
Fuchs, W. B. asst. biol. American. (Washington) proto. Dr 2.
Gustafson, A. H. instr. biol. Williams. bot. McInnis, Millfield.
Heiss, Mary E. grad. Wellesley. emb. H.
Kanrich, Dorothy grad. phys. Pittsburgh. phys. Pond, Gansett.
Hess, Margaret grad. res. fel. Virginia. phys. McLeish, Millfield.
Heyl, J. T. Hamilton. phys. Ka 24.
Hoover, Margaret E. Smith. emb. Robinson, Quissett
Kelly, Florence C. instr. biol. Simmons. proto. W c.
King, Florence A. grad. asst. phys. Wellesley. phys. H 7.
Kleinholz, L. H. K. instr. anat. Colby. emb. Ka 22.
Lawlor, Anna C. instr. biol. Saint Elizabeth. proto. Nickerson, Millfield.
Levin, Anna C. grad. Columbia. proto. W a.
Lewis, R. H. grad. entomol. Rochester. emb. Dr, attic.
Ling, S. grad. zool. Cornell. proto. Dr 9.
Lipmann, F. asst. phys-chem. Rockefeller Foundation. Br 206. D 209.
MacArthur, Mary Acadia. bot. H 7.
Manery, Jeanne F. grad. asst. phys. Toronto. phys. H 2.
Manther, J. I. grad. Columbia. proto. Ka 2.
McDonald, Clara M. Columbia. proto. Nickerson, Main.
McIntire, Josephine M. asst. phys. Mt. Holyoke. phys. Thomas, Buzzards Bay.
Metzner, J. J. grad. proto. Columbia. proto. Young, West.
Miller, Dorothy K. grad. Bryn Mawr. emb. Column Terrace (Falmouth).
Morris, J. E. grad. asst. biol. Fisk. emb. K 14.
Olsen, M. W. jr. poultry biol. U. S. Dept. Agr. emb. Ka 23.
Pappenheimer, Anne Radcliffe. phys. H 4.
Penn, A. B. K. C. grad. emb. Hopkins. emb. D 303.
Pfeifer, Katherine Washington (St. Louis). emb. Sanderson, High.
Primrose, Helen L. grad. Hunter. bot. Hilton, Main.
Riedman, Sarah R. instr. phys. Brooklyn. phys. Grinnell, West.
Roeder, K. D. instr. phys. Tufts. phys. Thomas, Buzzards Bay.

Rowland, C. R. asst. zool. Columbia. proto. Ka 21.

Runelles, R. W. DePauw. emb. Ka 23.

Russell, Dorothy M. grad. Pennsylvania Col. women. bot. Robinson, Quissett.

Scartterty, Louise E. instr. biol. Newcomb. emb. H 3.

Schott, Margaret H. asst. phys. Mt. Holyoke. phys. Thomas, Buzzards Bay.

Sims, J. L. De Pauw. emb. K 12.

Smith, Vera I. grad. fel. emb. Brown. emb. Hilton, Main.

Spangler, Betty A. Wheaton. bot. Young, West.

Specht, H. grad. Hopkins. phys. Dr 5.

Strongman, Louise E. Radcliffe. bot. Gifford, Government.

tum Suden, Caroline grad. res. fel. phys. Boston. phys. Grinnell, West.

Toothill, Martha C. instr. gen. biol. Adelphi. phys. W c.

Wagoner, K. S. grad. DePauw. emb. K 12.

Warbritton, Virgene res. asst. zool. Missouri. phys. Googins, Quissett.

Watkeys, Jean D. Rochester. Med. emb. H 6.

Weintraub, R. L. George Washington. bot. D 312.

Willis, Doris M. American (Washington). proto. McLeish, Millfield.

Wilhelm, Helen M. grad. Hunter. bot. Hilton, Main.

Wirtz, St. Mark instr. biol. St. Catherine. emb. Nickerson, Millfield.

Wismer, Virginia asst. bot. Pennsylvania. bot. Sanderson. High.

ADMINISTRATION

Billings, Edith secretary. Millfield.

Crowell, Polly L. asst. to the business manager. Main.

Dillinger, Bessie R. secretary. W i.

Laban, Katherine A. secretary. W e.

MacNaught, F. M. business manager. School.

LIBRARY

Blanchard, Hazel assistant. W g.

Endrejat, Doris assistant. W.

Lawrence, Deborah secretary. Locust (Falmouth)

Montgomery, Priscilla B. librarian. Whitman.

Rohan, Mary A. assistant. Millfield.

CHEMICAL ROOM

Frew, Pauline Bates. Wf.

Johlin, Sally Sorbonne (France). Gardiner.

Keil, Elsa M. instr. zool., N. J. Col. Women. W d.

Lackey, J. B. prof. biol. Southwestern (Memphis). A 203.

Laug, E. P. instr. phys. Pennsylvania Med. D 302.

Mast, Louise R. grad. Oberlin. Minot.

Richards, O. W. in charge. instr. biol. Yale. A 303.

Street, Sibyl grad. Chicago. McLeish, Millfield.

Strong, O. S. chemist emeritus. prof. neurol. and neuro-histol. Columbia. Elliot, Center.

Tupper, Mary C. Swarthmore. W h.

APPARATUS ROOM

Apgar, A. R. photographer. D 110.

Boss, L. F. electrician. Middle.

Graham, J. D. glass-blowing service. Veeder, Millfield.

Liljestrand, P. H. Ohio Wesleyan. asst. Dr 3.

Pond, S. E. asst. prof. phys. Pennsylvania. custodian. Gansett.

SUPPLY DEPARTMENT

Bulmer, Gladys bot. collector. H 9.

Croasdale, Hannah bot. collector. H 9.

Crowell, P. S., Jr. grad. zool. Harvard. collector. School.

Crowell, Ruth S. secretary. Main.

Erlanger, H. Wisconsin. collector. Dr 3.

Gray, G. M. curator res. museum. Buzzards Bay.

Gray, M. collector. (Teaticket)

Greenough, H. V., Jr. Harvard. Collector. Dr.

Hilton, A. M. collector. Millfield.

Kahler, W. collector. Glendon.

Leathers, A. W. head shipper, Minot.

Lehy, J. collector. Millfield.

Lewis, E. M. engineer. Cayadetta. Buzzards Bay.

McInnis, J. resident manager. Millfield.

Nielsen, Anna M. secretary. Clough, Millfield.

Poole, Marjory G. bot. collector. D 305.

Smith, C. B., Jr., Hamilton. collector. Supply Dep't.

Staples, S. Harvard. collector. Dr 3.

Thornley, W. Dartmouth. collector. Supply Dep't.

Veeder, J. J. captain, Cayadetta. Millfield.

Wamsley, F. W. supervisor of schools, Charleston, special preparator. Supply Dep't.

Wilcox, G. Yale. collector. Dr 3.

Wixon, R. fireman. (Falmouth)

BUILDINGS AND GROUNDS

Callahan, J. janitor. Ka 3.

Cornish, G. janitor. Br 1st floor. Dr 4.

Googins, H. janitor. Quissett.

Hemenway, W. carpenter. carpenter shop. Hawthorne.

Keltch, R. janitor. Br. 3rd floor. Millfield.

Look, G. janitor. OM S wing. Quissett.

Keltch, R. janitor. Br 3rd floor. Millfield.

McInnis, F. M. janitor. Bot & L. Millfield.

McManus, J. janitor. Br 2nd floor. Ka 3.

Rock, J. F. N. emergency man. Ka 3.

Russell, R. L. gardner. Hilton, Water.

Russell, M. R. night watchman.

Swain, G. R. janitor. Br 3rd floor. Main (Quissett)

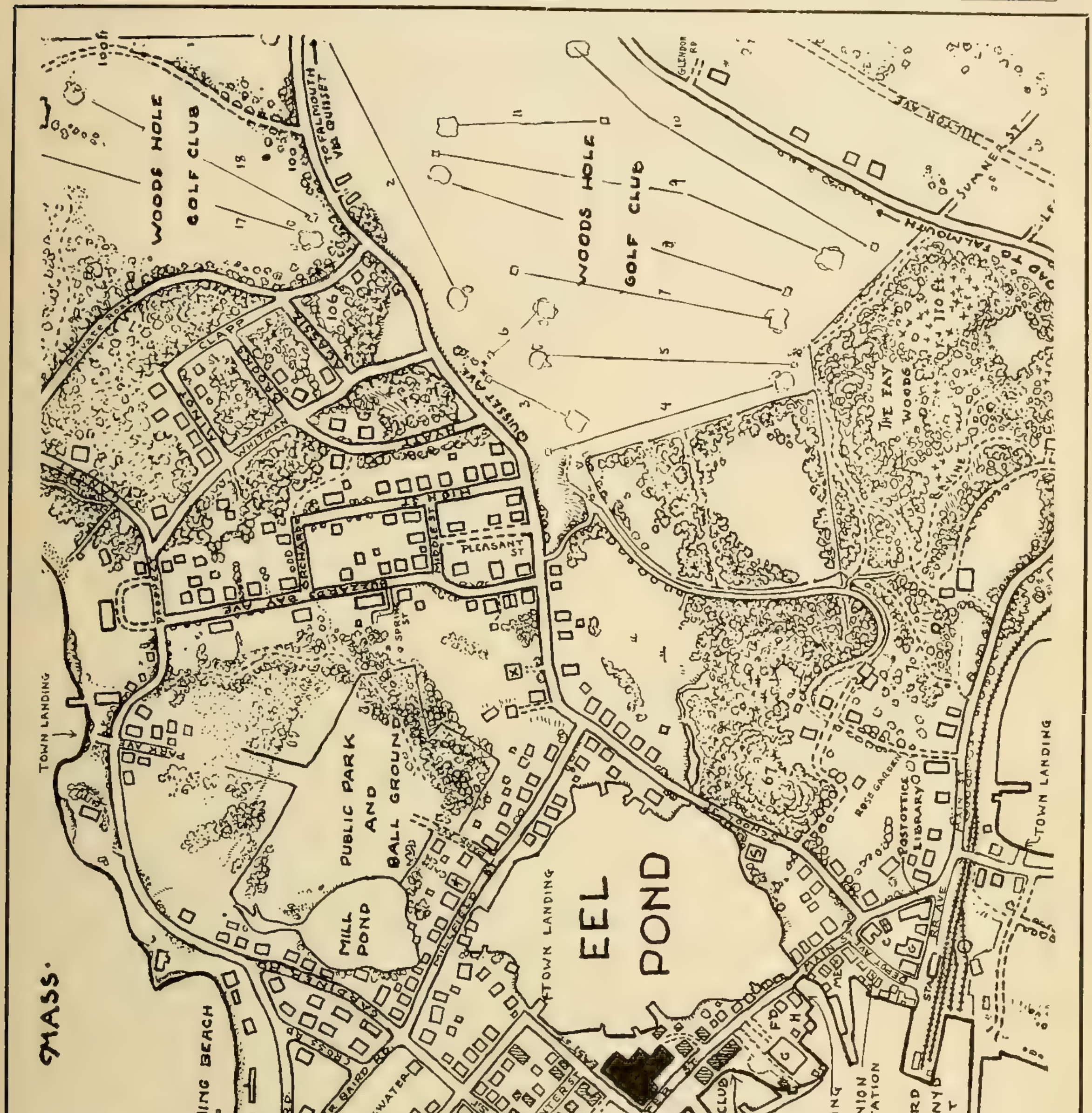
Tawell, T. E. storekeeper and head janitor. basement Br Thompson, Water.

MECHANICAL DEPARTMENT

Meier, Otto night mechanic. Dr 15.

Kahler, R. assistant. Br 7. Glendon.

Larkin, T. superintendent. Br 7. Woods Hole.


MASS.
WOODS HOLE GOLF CLUB
WOODS HOLE GOLF CLUB
TO FALMOUTH VIA QUISSET
QUISSET AVE
CLAPP
WHITMAN
PLEASANT ST
MIDDLE ST
ORCHARD
BUZZARDS BAY AVE
SPRING ST
PARK AVE
TOWN LANDING
PUBLIC PARK AND BALL GROUND
MILL POND
MILLFIELD ST
EEL POND
TOWN LANDING
BATHING BEACH
GARDINER RD
CROSS RD
SPENCER BAIRD
THE BREAKWATER
GOSNOLD RD
NORTH ST
WEST ST
CENTER ST
WATER ST
EAST ST
TOWN LANDING
COAST GUARD
U.S. FISH COMMISSION
BASIN
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WOODS HOLE OCEANOGRAPHIC INSTITUTION
CLUB
HARBOR
TOWN LANDING
WESTERN UNION
RAILROAD STATION
STEAMBOAT
NEW BEDFORD
MARTHAS VINYARD
NANTUCKET
MAGNETIC AND TRUE NORTH
THE FAY WOODS
RAVINE
ROSE GARDEN
POSTOFFICE
LIBRARY
MAIN ST
TOWN LANDING
ROAD TO FALMOUTH
SUMNER ST
GLENDON RD

The A. B. C. of Woods Hole for 1932

All Schedules Set to Daylight Saving Time

GENERAL INFORMATION

Library Hours

Wednesdays and Saturdays

3:00 - 5:00
7:00 - 9:00

June 15 - October 15

WESTERN UNION

Office Hours

Week Days
8:00 A. M. to 10:00 P. M.

Sundays

9:00 to 11:00 A. M.
4:00 to 6:00 P. M.

POST OFFICE

These hours effective June 20, 1932.

Week Days

Due to Arrive at P.O.	Window Open	Due to Leave P.O.
6:50 A.M.		6:45 A.M.
10:35 A.M.	11:00	9:25 A.M.
3:35 P.M.	4:15	5:10 P.M.
6:09 P.M.	6:30	

Sundays

Due to Arrive at P.O.	Window Open	Due to Leave P.O.
10:40 A.M.		5:45 P.M.

Office Hours

Opens	Closes
7:00 A. M.	7:50 P. M.

No money orders or registry business transacted after 6:00 P. M.

BOAT SCHEDULE

For New Bedford, Woods Hole, Oak Bluffs, Vineyard Haven and Nantucket

Leave	Daily A.M.	Daily A.M.	Daily A.M.	Daily P.M.	Daily P.M.	Daily P.M.
New Bedford	7:00	9:30	11:45	2:30	5:00	7:40
Woods Hole	8:20	10:50	1:05	4:00	6:20	8:55
Oak Bluffs	9:10	11:40	1:55	4:45	7:10	....
Vineyard Haven	....	....	....	....	....	9:40
Nantucket	11:30	2:00	4:15	7:15	9:30	....

Leave	Daily A.M.	Daily A.M.	Daily A.M.	Daily P.M.	Ex. Sun. P.M.	Sunday P.M.	Daily P.M.
Nantucket	....	6:30	9:00	12:00	2:30	3:00	4:45
Vineyard Haven	6:10	....	....	....	....	....	....
Oak Bluffs	....	9:00	11:20	2:15	4:30	5:00	7:00
Woods Hole	6:55	9:45	12:10	3:05	5:20	5:50	7:45
New Bedford	8:15	11:15	1:45	4:30	6:45	7:30	9:15

TRAIN SCHEDULE

Woods Hole to Boston — Week-days

	Daily A.M.	Daily A.M.	Daily P.M.	Daily P.M.	Daily P.M.	Sunday P.M.	Sunday P.M.	Sunday P.M.
Woods Hole	7:15	9:55	12:25	3:20	5:40	12:25	6:15	8:10
Falmouth	7:22	10:02	12:33	3:27	5:47	12:33	6:22	8:17
Boston	9:10	12:08	2:10	5:30	7:52	2:10	8:23	10:22

Boston to Woods Hole — Week-days

	Daily A.M.	Daily A.M.	Daily A.M.	Sat. P.M.	Daily P.M.	Daily P.M.	Daily P.M.	Daily P.M.	Sundays P.M.
Boston	7:00	8:15	11:00	1:03	1:25	1:30	4:03	4:47	8:30
Falmouth	9:18	10:28	12:33	3:00	3:27	3:47	6:02	6:48	10:34
Woods Hole	9:25	10:35	12:40	3:06	3:35	3:55	6:09	6:55	10:40

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
July 2	3:52	3.57
July 3	4:34	4:40
July 4	5:17	5:24
July 5	6:02	6:09
July 6	6:44	6:56
July 7	7:30	7:45
July 8	8:17	8:37
July 9	9:05	9:32
July 10	9:57	10:29
July 11	10:51	11:28

In each case the current changes approximately six hours later and runs from the Sound to the Bay. It must be remembered that the schedule printed above is dependent upon the wind. Prolonged winds sometimes cause the turning of the current to occur a half an hour earlier or later than the times given above. The average speed of the current in the hole at maximum is five knots per hour.

RELIGIOUS SERVICES

Church of the Messiah—Episcopal

Communion 8:00
Morning Prayer 11:00
Evening Prayer 7:30

Methodist Episcopal Church

Morning 10:30
Evening 7:30
Thursday Prayer Meeting 8:00

St. Joseph's Roman Catholic Church

Morning Mass .... 7:00 A. M.
" " .... 8:15 A. M.
" " .... 9:30 A. M.
Evening Mass .... 7:30 P. M.

SEAPLANE SCHEDULE

New Bedford and Woods Hole to Vineyard Haven — Nantucket

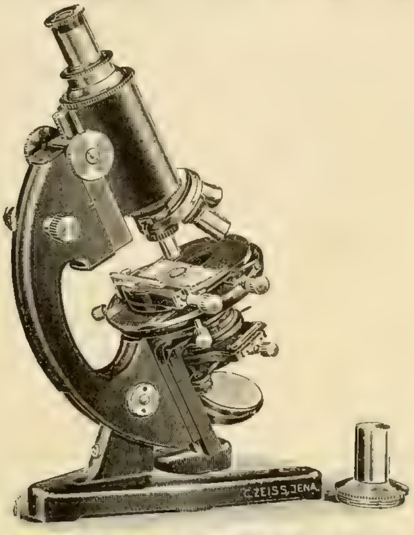
		A.M.	P.M.	P.M.	P.M.	P.M.
New Bedford	Lv.	7:00	10:30	12:30	*3:30	6:00
Woods Hole	Lv.	7:17	†10:47	†12:47	†3:47	†6:17
Vineyard Haven	Arr.	7:21	10:51	12:51	3:51	6:21
Nantucket	Arr.	7:46	11:16	1:16	4:16	6:46

Nantucket — Vineyard Haven to Woods Hole — New Bedford

		A.M.	P.M.	P.M.	P.M.	P.M.
Nantucket	Lv.	8:15	11:30	*2:30	4:50	6:55
Vineyard Haven	Lv.	8:40	11:55	2:55	5:15	7:20
Woods Hole	Arr.	8:44	†11:59	†2:59	†5:19	
New Bedford	Arr.	9:01	12:16	3:16	5:36	‡7:33

* Begins June 30. † Meets Boston Trains ‡ Meets N. Y. Boat on its schedule

All Schedules Subject to Change Without Notice


C.ZEISS JENA

THE WOODS HOLE LOG

"MAGNOLIA"

The Theatre Unit showed wisdom in choosing Booth Tarkington's "Magnolia" as the opening piece of their summer's repertoire. The play is a clever satire on the theme of southern chivalry. It is a fast-moving, entertaining story of a boy who is driven from his home because he refuses to fight on a question of honor. As a result of this, he becomes a notorious killer, inspiring great terror in the hearts of the residents of the lower Mississippi regions. After this occurs, he is welcomed back by his family, which now worships him for his bravado. However, the girl whom he loves despises him for his brutality.

The second act, laid in General Jackson's gambling resort, was as well done as anything on Broadway, and the atmosphere created by it could not have been improved upon. Whoever played the accordian did some excellent improvisation, for he was in complete harmony with the spirit of the play, using minor notes when the play touched a melancholy strain, and, when the action increased in tempo, improvising appropriately. Mention should also be made of the person who played dice, as well as of the voices backstage.

Mexico, the mulatto, played by Katherine Squire, played her rôle beautifully; her daughter and her walk could not have been more appropriate to the character. Captain Blackie, the victorious killer, was played in excellent fashion by Myron McCormick. Mr. McCormick has a high reputation to live up to, because he has done such good work in the past few years. Lucy, played by Merna Pace, was a charming character. I think that she and Peter Wayne, who had the leading part, could have endeavored to make the last act move faster, and for this reason it was in great contrast to the second act.

Considering that Bretaigne Windust has a marked English accent, his characterization of the negro Rumbo was excellent, and most amusing at times. He managed to make a great deal more of his part than is called for in the play.

I believe that everyone enjoyed the negro singing which occurred before the first act and at the end of the last. It lent a highly realistic atmosphere to the production, and rounded out the whole production far more fully than anything else could have done. —*Vera Warbasse.*

THE THEATRE UNIT PRESENTS "THE GHOST TRAIN"

"The Ghost Train" will be the second play on the Theatre Unit's production list. Beginning Monday, July 4, it will run through the week at Old Silver Beach, West Falmouth.

Hardy perennial of mystery plays, "The Ghost Train" comes as an interlude between "Magnolia" and "Berkely Square". Strangely enough, although this play had the longest run of any piece on a Boston stage, it never travelled far from that city. Therefore, the summer peeople on the Cape who come from all over the country will have an opportunity to see a play they must certainly have heard discussed many times.

They say that there has not been a fire on Penzance Point for ten years. This may account for the great excitement in Woods Hole when the whistle blew number 39 the other evening. The fire engines rushed out to the Franklin Park's estate with a record-breaking trail of cars behind it. However, the fire was a disappointment, for it was only a smoky brush fire on the beach, for which Mr. Park had a permit from the fire department.

On Saturday, July 2, the garden of Mr. and Mrs. Franklin A. Park was the scene of the wedding of their daughter Miss Marjorie Park to Mr. Gerald Swope, Jr. The Bride's sister-in-law, Mrs. Malcolm Park, attended her, and the Bride's two brothers, Franklin Park and Malcolm Park were ushers.

A large boat was reported on the reef off Nantucket Island. On Thursday a barge was taken over there with four large pontoons which will be filled with water and placed below the boat. The water will then be pumped out and the boat lifted off the reef.

The first race of the Quissett Yacht Club will be held on Saturday, July 2. There will be a race for gaff rigged knockabouts and a race for the "S" class knockabouts. After the race, the annual meeting of the Yacht Club will be held in Dean Emery's Boat house, when racing matters will be discussed.

Rolf Kaltenborn will teach tennis again this summer. He is staying at Mrs. Stewart's cottage.

THE COLLECTING NET

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THE ACTION OF ULTRA-VIOLET RAYS ON AMOEBA PROTOPLASM

DR. L. V. HEILBRUNN
Associate Professor of Zoology, University of Pennsylvania

One of the most essential and perhaps the most striking characteristic of living protoplasm is its capacity to be profoundly modified by various agents or stimulants which arouse it to activity. Widely diverse types of living material are stimulated by weak electric currents, by uneven pressure, and by ultra-violet radiation.

The most generally accepted theory of stimulation is that the process involves an increase in the permeability of the plasma membrane or osmotic membrane of the cell. This theory has had a profound effect on physiological thought and physiological experimentation, but, true or false, it gives no information concerning the changes which the main mass of the protoplasm undergoes when the cell is thrown into activity.

Some time ago, I came to the conclusion that stimulation involves a (*Continued on page* 58)

M. B. L. Calendar

SEMINAR: JULY 12, 8:00 P. M.

Dr. Kenneth S. Cole: "The Electric Phase Angle of Tissues."

Dr. Margaret Sumwalt, Dr. W. R. Amberson, and Miss Eva Michaelis: "The Part Played by Diffusion Potentials in the Origin of Concentration Potential Differences across Frog Skin."

Dr. E. N. Harvey and Dr. D. A. Marsland: "The Tension at the Surface of Amoeba dubia"

Dr. E. N. Harvey: "The Beams Air Turbine for Biological Centrifuging."

LECTURE: JULY 15, 8:00 P. M.

Dr. Rudolf Mond, Kiel University: "Regulations of Ions in the Body Tissues."

THE JOHN INNES HORTICULTURAL INSTITUTION

DR. C. D. DARLINGTON
Cytologist, The John Innes Horticultural Institution

John Innes was a merchant of the City of London who died in 1904 and left his fortune for the endowment of an institution which should work for the promotion of horticulture. The Institution was established at Merton, near London, in 1910, and William Bateson was appointed its first director. Bateson had been largely concerned in the development of the young science of genetics, and the promotion of horticulture, so far as scientific research was concerned, naturally took the form of plant breeding. The early work followed three main directions.

The most important at first was the study of problems of mendelian inheritance, especially linkage in *Primula* and *Pisum*. Later, Bateson himself devoted a great deael of attention to anomalies of inheritance, especially to those following somatic mutation and giving rise to chimareas in ferns and flowering plants.

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Artificial chimaeras of great morphological interest were raised in Solanum. The third main direction was the study of inheritance and sterility in fruits. A great deal of progress was soon made in the analysis of self-sterility, especially in *Prunus*, but other problems involving hybrids and polyploids did not yield to mendelian analysis. These required a study of chromosome behavior.

In 1923 Bateson appointed a cytologist, the late W. C. F. Newton, to the staff. The cytological work that has followed has largely been related to systematic or genetical studies undertaken in the Institution. The systematics of *Tulipa, Crocus, Dahlia, Prunus, Tradescantia* and many other genera have been related with variation in the form and number of their chromosomes. The origin of new polyploids such as *Primula Kewensis, Digitalis mertonensis* and giant forms in *Campanula* and *Rubus* has been made out. The origin and inheritance of "ring formation" where four or more chromosomes are associated at meiosis in diploids have been analyzed in *Pisum* and *Campanula*. The occurrence of generational sterility has been shown in most fruits to depend on a numerically abnormal chromosome outfit. The ever-sporting character in stocks has been found to be due to a chromosome deficiency which acts as a lethal. The origin of mutants in polyploids, such as fatuoids in oats, has been shown to be one to a pairing of dissimilar chromosomes which is occasionally possible in such polyploids.

Apart from these direct effects, chromosome studies have stimulated further genetical work, especially the study of segregation and linkage in tetraploid *Primula, Rubus*, tomato and in octoploid *Dahlia*. Recently it has also become possible to analyze the more complex inheritance found in ring-forming peas.

If the chromosome theory of heredity is true, it should be possible to study certain of the properties of heredity of an organism from its chromosomes, just as it should be possible to study certain of the properties of its chromosomes from its system of heredity. It is particularly necessary in developing the theory of heredity to make such parallel observations because the same organisms are rarely suitable for both kinds of study. The work attempted on these lines at Merton has been useful, first, in determining the conditions of pairing of chromosomes at meiosis, a closer knowledge of which is necessary for the analysis of chromosome behavior in hybrids, and, secondly, in the study of the behavior of the chromosomes at the time when crossing over is supposed to occur between them. While this work has helped to establish a closer relationship between the chromosomes and heredity, it has also helped to make the study of the chromosomes an independent tool of investigation.

On the death of Bateson in 1926, Sir Daniel Hall became Director, and the work of the Institution has continued to develop along the same lines. The phenomenon of "breaking" in tulips has been shown to be due to a virus infection carried by aphides. The work of Harrison on the induction of melanism in moths has been repeated on a large scale with negative results. An X-ray apparatus has been installed and many species of plants are being treated. Many of the genetical and cytological problems have been subjected to closer mathematical treatment under the direction of Professor J. B. S. Haldane.

The Institution lies in its gardens of about fourteen acres. The research workers usually number about twenty, of whom most are engaged on both genetical and cytological studies. They work chiefly on their individual initiative rather than by group collaboration. Their published results are found mostly in the *Journal of Genetics, Genetica, Cytologia, The Journal of Pomology*, and the *Proceedings of the Royal Society*.

THE ACTION OF ULTRA-VIOLET RAYS ON AMOEBA PROTOPLASM

(Continued from Page 57)

gelation, that is to say, a sharp increase in the viscosity of the protoplasm, and I felt, moreover, that this gelation was in a number of ways akin to blood clotting. Thus the clotting of protoplasm requires the presence of free calcium, just as does the clotting of blood.

Ultra-violet rays are general protoplasmic stimulants. They have an effect on muscle, nerve, egg cells, streaming plant protoplasm, etc. It is of interest, therefore, to determine the effect of these rays on the viscosity of the protoplasm.

Centrifuge tests of protoplasmic viscosity made on *Amoeba dubia* showed that the rays caused on the average a 500 per cent. increase in protoplasmic viscosity. This gelation did not occur if calcium was first removed by immersing the Amoebae in dilute solutions of ammonium oxalate. Thus there is support for my view that stimulating agents cause a gelation and that this gelation is associated in some manner with the presence of free calcium. These results are in accord with the earlier work of Miss Young and myself on the Arbacia egg.

But in the present study it was possible to push the analysis a step farther. In viscosity studies of amoeba protoplasm one can determine the viscosity both of the interior protoplasm and of the outer cortical protoplasm or plasmagel. The data presented for *Amoeba dubia* concern only the interior. By centrifuging *Amoeba proteus,* it is possible to obtain information concerning an outer cortical ring of stiffer protoplasm, the plasmagel. This layer is thicker in *Amoeba proteus* than in *Amoeba dubia,* and when *proteus* is centrifuged, it is a simple matter to obtain information concerning the consistency of the plasmagel.

It is easy to show that ultra-violet rays cause a very pronounced liquefaction of the plasmagel. In numerous experiments this result was always obtained. Now it should be remembered that Heilbrunn and Daugherty (1932) showed that the stiffness of the plasmagel depends on the presence of calcium. As a matter of fact, it can be shown that removal of calcium has the identical effect as irradiation.

Inasmuch as the interior protoplasm of Amoeba is stiffened by ultra-violet rays and the cortical protoplasm is liquefied, and that both these processes apparently depend on calcium, one is drawn toward the hypothesis that ultra-violet radiation causes a release of calcium from the plasmagel and that this calcium diffuses into the interior and causes gelation there. In favor of this hypothesis is the fact that ultra-violet rays can release calcium both from non-living colloids and from living cells. But if we are to accept such a view, it should be possible to show that shorter or less intensive exposures to ultra-violet cause a liquefaction of the interior protoplasm. For earlier data has shown conclusively both for Amoeba and for the protoplasm of various plant and animal cells that a small amount of calcium causes a liquefaction of the main mass of the protoplasm, and only a relatively large amount of free calcium causes gelation. If, then, calcium is released from the cortex by ultra-violet rays and it is this calcium diffusing into the interior that causes gelation there, short exposures to radiation should cause liquefaction of the interior protoplasm, and there should also be a preliminary liquefaction following somewhat longer exposures. Both these predictions were verified. Following very brief exposures to ultra-violet, the viscosity of the interior protoplasm of the Amoeba drops sharply, rising within a minute or two to the normal value. When somewhat longer exposures are employed, the viscosity also drops, but this drop is then followed by the sharp rise above normal which was previously noted.

As far as the experiments go, therefore, the hypothesis fits the facts, and we have reason to believe that the effect of ultra-violet rays is to cause a breakdown of the cortical protoplasm, a breakdown which releases calcium to the interior, where it causes first liquefaction and then gelation of the main mass of the protoplasm.

THE WOODS HOLE OCEANOGRAPHIC INSTITUTION*

The Woods Hole Oceanographic Institution, founded in 1930, is a research establishment supported by endowment. While it is wholly independent in organization, close association with universities and other educational bodies is assured through the personnel of its Board of Trustees, listed herewith.

The purpose of the Institution, as stated in its charter and as its name implies, is to encourage and carry on the study of oceanography in all its branches. To this end it maintains at Woods Hole a marine laboratory which serves as the headquarters of its regular staff and where visiting investigators, from this country or abroad, will be made welcome under the conditions outlined in this announcement.

The location of the laboratory at this particular point on the coast line was based on the combined advantages of close proximity to the Marine Biological Laboratory and the laboratory of the U. S. Bureau of Fisheries, and of the exceptional opportunities for illustrative investigations in the major divisions of oceanography that are afforded by the neighboring waters.

The nearness of Woods Hole to the transition zone between inshore and oceanic waters, the abruptness of this transition, and the nearness to the continental abyss and ocean basin, make this a particularly favorable headquarters for investigation into many of the basic problems in physical oceanography that are now engaging scientific attention. The Gulf of Maine, with its tributaries, is also close at hand. Here the concentration within a relatively small area of a wide variation in depths, in bottom contours, in the prevailing types of circulation, in temperatures and salinities, and in the fertility of the water for pelagic plants and animals, offers a more promising field for investigations into various aspects of the relationship of oceanic biology to the physics and chemistry of the sea than does any other region of comparable extent in north-eastern America.

Thus there are few oceanographic problems but can be attacked profitably at Woods Hole, unless primarily associated either with tropical shallows, with Arctic ice or with mid-oceanic conditions. And operation of a seagoing research ship by the institution makes Woods Hole a convenient head-

*The material in this article has been extracted practically unaltered from the last annual announcement of the Woods Hole Oceanographic Institution.

quarters for studies in the last two of these fields, by making trips possible on the one hand to the Arctic discharge from Davis Strait, and on the other to the open Atlantic basin, with Bermuda in the offing as an offshore base. Arrangements have been made by which visitors from the Woods Hole Oceanographic Institution may enjoy the laboratory facilities of the Bermuda Biological Station for Research.

The distance from Woods Hole to the mouth of Vineyard Sound is fifteen miles; to the Gulf of Maine via Vineyard and Nantucket Sounds, forty miles; to Massachusetts Bay via the Cape Cod Canal, twenty miles; to the continental slope in the offing of Martha's Vineyard, about one hundred miles.

The main building is a four-story brick and concrete structure 136 ft. long by 50 ft. deep, of the simple type of construction usual in modern laboratories. In the basement are the receiving and shipping rooms, boiler room, battery and transformer rooms, the storeroom for chemical and other apparatus, a room in which constant temperature can be maintained, a refrigeration room, and one laboratory containing concrete aquaria, some of which are piped with chilled as well as unchilled sea water. There is also a machine shop, for the repair and construction of apparatus used in the laboratory and on the ship.

The first floor contains the offices, the director's room, a large chemical laboratory and nine smaller research laboratories. On the upper floors are the reading room, chart room, camera and drafting room, two dark rooms for experimental work, one camera dark room and twenty-three research laboratories, one of which is fitted as an aquarium room. Eight of the research laboratories, in addition to the large chemical laboratory, are provided with fume hoods. Most of the rooms have salt water tables of the type now widely used in marine biological laboratories, while other rooms are designated for physical investigations. Sixteen of the laboratories are designed for individual use, the others for use of groups of two or more investigators. The rooms are simple but adequately fitted with tables, counters, drawers and the usual movable furniture. Each is provided with a sink with fresh water (in addition to the salt water tables just mentioned), with gas, and with electric outlets for power as well as for light. Adequate heating is provided for winter occupancy, and it is planned to keep the laboratory in operation the year round.

The salt water intake is located at the end of the dock, where the depth of water and activity of tidal circulation prevent any danger of contamination. The supply is driven by lead pumps to concrete paraffin-lined tanks of 12,500 gallons capacity in the attic, from which the flow to the laboratories is by gravity. All piping for salt water is of chemically pure lead to insure that the supply delivered to the aquaria shall be free from toxic substances. A limited supply of chilled sea water is also available in the aquarium room in the basement.

Through the courtesy of the Marine Biological Laboratory the staff and visitors to the Woods Hole Oceanographic Institution enjoy the full facilities of the former's library, which makes it unnecessary for the Institution to maintain one of its own. This library already contains an excellent selection of the more important oceanographic titles and serials, in addition to the more strictly biological, and is being constantly expanded in this direction by the aid of contributions by the Oceanographic Institution. A small working collection of books and a supply of charts will also be provided in the reading and chart rooms.

The Institution owes its unique position among research institutions to its excellent marine equipment, which includes two sea-going vessels for work both near shore and in the open ocean.

1. The research ship *Atlantis* is a steel ketch with 250 h. p. Diesel engine designed for a speed under power alone of about eight knots, and with a sufficient spread of canvas to sail well. The cruising radius under power alone is about 3,000 miles, which can be extended indefinitely by sail. Her dimensions are 142 ft. length over all, 29 ft. beam, 17 ft. extreme draft, about 380 tons displacement. The living accommodations for the scientific staff include single and double cabins for six persons, while additional dormitory space can be arranged, ample toilet facilities and comfortable dining and lounging saloon. There are two laboratories, one on the upper and one on the lower deck, providing facilities not only for biological but for chemical and physical investigations on board. And experience has shown that delicate chemical manipulations can be carried on successfully on *Atlantis,* at sea.

On extended cruises on the high seas comfort and steadiness are essential for an oceanographic research vessel, and *Atlantis* has been especially designed with this in view. Safety is insured by heavy construction, in all details meeting the most exacting specifications. The ship's company of officers and crew numbers about seventeen. Her special equipment includes a heavy duty electric winch for handling large nets, trawls, and so forth, carrying 30,000 feet of dredging wire, a light duty electric winch for hydrological observations, a wire sounding machine (also electric), while sonic apparatus will be installed later. With this equipment, work in all fields of oceanography can be carried on at any desired depth. *Atlantis* carries a wide variety of tow nets, trawls, etc., deep sea thermometers, water bottles, and in general a thoroughly modern oceanographic equipment. From her it is possible to carry on, not only the more conventional lines of work such as deep towing, dredging and trawling, collection of water samples and records of subsurface temperatures, but also chemical analyses of the sea water, gas analyses, study of hydrogen ion concentration, collection and study of submarine sediments, studies of circulation, and various meteorological observations.

2. The launch *Asterias,* 40½ ft. long, 12½ ft. broad, with draft of 4 ft. is of the type commonly used for flounder dragging and for offshore fishing in the region. She is powered with gasoline engine to give a speed of nine knots and has comfortable living quarters for four men for short cruises. Her pilot house includes a small laboratory, while a large uninterrupted deck facilitates the handling of various gear. She is provided with a hoisting apparatus with wire rope. Scientific equipment includes nets, hydrological instruments, and bottom samplers. *Asterias* is designed for general oceanographic work down to depths of one hundred fathoms within a few day's run of Woods Hole.

A small appropriation is set aside for the appointment of Research Assistants, who are qualified to carry on investigations in oceanography, either individually or under supervision of the staff. The holders of such appointments will be expected to take part in one or more oceanographic cruises, either on *Atlantis* or on *Asterias,* according to circumstances.

The term of appointment, and stipend, will be based on the circumstances of each case. But appointments will not ordinarily be made for terms of less than three months. Arrangement as to residence, whether at Woods Hole or at some university, will also be decided as may seem most suitable for the particular investigation on which the holder of the assistantship is engaged. Each assistant will be expected, at the expiration of his appointment, to submit a written report on his work. And no application for a second term will be accepted unless such report be deemed satisfactory. Applications should reach the Director not later than April 1.

Visiting investigators will be made welcome so far as the facilities of the laboratory allow. Anyone planning to visit the Institution should communicate with the Director as far in advance as possible, stating in detail the nature of the investigation to be pursued, apparatus and marine equipment needed, and any other information which may assist in the decision whether his needs can be met. Accommodations for visiting investigators will include either separate rooms or space in larger rooms, adequate fittings, and all ordinary apparatus, supplies and glassware for chemical, physical or biological investigation of the kinds that can be appropriately undertaken at this laboratory. The question whether animals or plants, or samples of sea-water or of sea-bottom, needed for any particular investigation, can be supplied, must be decided for each individual case; no general statement can be made in this respect. Special arrangements must be made if unusually expensive apparatus or reagents are required. Attention is drawn to the fact that the electric current supplied to the laboratory is alternating, 230 volts for power and 115 volts for lighting. Direct current cannot be supplied. Compressed air can be provided only in movable apparatus. Minor supplies can be purchased at the supply department of the Marine Biological Laboratory.

In special cases facilities will be available for visitors to carry out investigations at sea, from *Atlantis.* Whether this can be arranged will depend, in each instance, on the nature of the investigation planned, on the space available on the ship, and on the probability that the applicant is adapted to sea life.

The fee for the occupancy of a private room is ordinarily at the rate of $50 per month, which includes the use of all usual apparatus and supplies, and (so far as possible) the material for investigation as explained above. But the Director is empowered to remit this fee if, in his opinion, the importance of the contemplated investigation warrants so doing.

The Trustees wish to emphasize that the facilities of the laboratory and of the research vessels are primarily intended for those who wish either to collaborate with members of the staff in the regular station program or who are engaged in their own researches in some branch of oceanographic science. Applications cannot ordinarily be accepted from visitors wishing to work at the laboratory in any other subjects.

[No formal course of instruction will be offered at the institution. But the laboratory proposes to arrange opportunity for a limited number of graduate students to obtain training in the field methods of oceanography during the summer months, through taking part in the station program, including the offshore cruises in which they will be expected to assist. Occasional seminars and lectures will be given by members of the staff and students will ordinarily be expected to work under the supervision of some member of the staff. The fee for such instruction will be $75 for the summer season, payable in advance.

The laboratory will not certify to the attainments of any students in any course of study that may be pursued.

Students wishing to visit the laboratory should communicate with the Director as early in the spring as possible, addressing him at the Museum of Comparative Zoölogy, Cambridge, Mass.

The number of students that can be received in any summer is limited. Selection will, therefore, be made on the basis of past training and of prospective fitness of each applicant for marine investigations. Every student visiting the institution will be expected to submit a written report (not necessarily for publication) on his work at the termination of his visit. And no student will be considered for a second visit unless this report shows evidence of satisfactory work.]

It is the purpose of the institution to maintain an oceanographic periodical. This will give opportunity for the prompt publication of investigations in appropriate fields carried on at the Woods Hole laboratory or elsewhere. Details of this project are still under consideration.

The institution carries on a regular program of oceanographic investigation in three main fields, physical and chemical, geological, and biological, under direction of the members of the staff.

A series of quarterly cruises on *Atlantis* have been initiated in the western Atlantic covering a triangle between Chesapeake Bay, Bermuda and Nova Scotia, coördinated with similar explorations that are carried out in the eastern Atlantic under the auspices of the International Council for the Exploration of the Sea. The first object of this work will be to trace the periodic fluctuations in the characteristics of different phases of oceanography in the North Atlantic. Other cruises are also undertaken at other times of year.

Field work near shore in the immediate vicinity of Woods Hole is ordinarily carried on from *Asterias.*

Investigations in the following topics are now in progress under the direction of the staff members named below.

1. Normal state and seasonal variations of the waters on the continental shelf, and of the zooplankton, Cape Cod to Chesapeake Bay, based on investigations by the U. S. Bureau of Fisheries steamer *Albatross II*, and by *Atlantis*. In charge of Henry B. Bigelow.

2. Studies of thermal distribution and variation at the surface of the western North Atlantic based on thermograph readings taken on commercial steamship routes. In charge of Charles F. Brooks and Henry B. Bigelow.

3. Physiology of the marine zooplankton. In charge of George L .Clarke.

4. Study of dynamic circulation in the North Atlantic Basin. In charge of C. O. Iselin.

5. Investigations of the hydrology of Baffins Bay based on the explorations of the Coast Guard Patrol boats *Marion* and *General Greene*. In charge of Olav Mosby, Senior Physical Oceanographer, U. S. Coast Guard.

6. A study of the variation in chemical composition of sea water, with respect to some minor constituents, especially nitrites, arsenic and the heavy metals. In charge of N. W. Rakestraw.

7. Study of the physical chemistry of the respiratory proteins with special reference to factors affecting the transport of oxygen and the bearing of these relations on the distribution of animals in the sea. In charge of Alfred C. Redfield.

8*a*. The stress exerted by the wind as a propulsive force on the surface of the ocean related to the average distribution of wind direction and wind velocity with elevation, as obtained from pilot balloon observations. In charge of C. G. Rossby.

8*b*. Thermal interchange between sea surface and superimposed air as determined by temperature and salinity lapse rates, and by measurements of evaporation. In charge of C. G. Rossby.

9. An investigation of the distribution, consumption and regeneration of phosphates and of other compounds of phosphorus in the water and bottom deposits of the western Atlantic. In charge of H. R. Seiwell.

10. Studies of the sediments on the continental shelf, together with their environments, past and present. In charge of Henry C. Stetson.

11*a*. The distribution of bacteria in sea water and sea bottom.

11*b*. The rôle of bacteria in the cycle of life in the sea, with special emphasis upon the decomposition of organic residues and the cycle of nitrogen. In charge of Selman A. Waksman.

12. Study of hydrology, bottom deposits, and other oceanographic features of the Arctic Ocean to the north of Spitzbergen, based on explorations of the submarine *Nautilus* in 1931, under the command of Captain Sir Hubert Wilkins.

The staff consists of permanent scientific members and of research associates appointed for definite terms. The present personnel is as follows:

Henry B. Bigelow, Professor of Zoölogy, Harvard University, Director.

George L. Clarke, Tutor and Instructor, Harvard University, Junior Biologist.

C. O. Iselin, II, Assistant Curator of Oceanography, Museum of Comparative Zoölogy, Research Associate in Physical Oceanography and Master of the research vessel *Atlantis*.

Olav Mosby, Senior Physical Oceanographer, U. S. Coast Guard, Research Associate in Oceanography.

Norris W. Rakestraw, Assistant Professor of Chemistry, Brown University, Research Associate in Physical Chemistry.

Alfred C. Redfield, Professor of Physiology, Harvard University, Senior Biologist.

C. G. Rossby, Associate Professor of Meteorology, Massachusetts Institute of Technology, Oceanographer.

H. R. Seiwell, Investigator in Oceanography.

Henry C. Stetson, Assistant Curator of Paleontology, Museum of Comparative Zoölogy, Research Associate in Submarine Geology.

Selman A. Waksman, Microbiologist, New Jersey Agricultural Experiment Station, Marine Bacteriologist.

Captain Sir Hubert Wilkins, Research Associate in Oceanography.

* * * *

Miss Virginia B. Walker, Secretary and Administrative Assistant.

Mr. William Schroeder, Superintendent of Buildings and Grounds.

OFFICERS

President of the Corporation: Frank R. Lillie, University of Chicago.

Treasurer: Lawrason Riggs, Jr., New York.

Clerk of the Corporation: Henry B. Bigelow.

THE SUPPLY DEPARTMENT OF THE MARINE BIOLOGICAL LABORATORY

By the Staff of the Supply Department

One of the main duties of the Supply Department during the summer season is to give the investigators and students the very best possible service.

The available materials will be collected and delivered to all those who request them. Orders for material to be delivered the following day will be taken between 10:00 A. M. and noon-time. If the investigator who does not expect to be in his room between those hours will leave a notation of what he desires, it will greatly facilitate the service. This may be done by placing a slip on the door; then he may be sure that the boy will take it and the material be delivered.

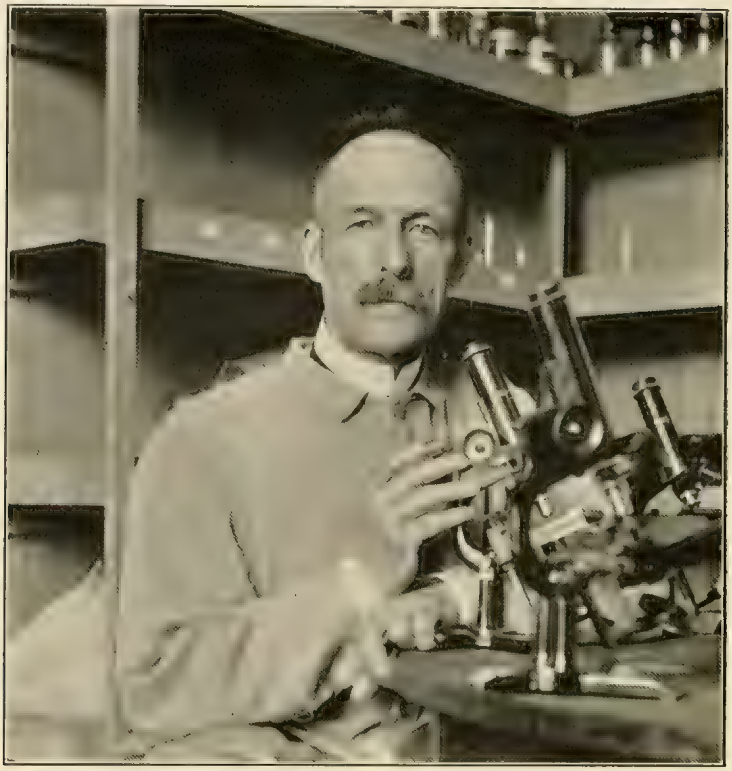
If there are any complaints about the material or service, it would be greatly appreciated if they were entered in the Supply Department office, instead of being given to the delivery boy or to a member of the crew.

This department is maintained at a very great expense during the summer months. During the winter months, the Supply Department is maintained as a Supply House, where students and teachers may order their needs for their class work. The all-year-round personnel is made up of six collectors, and in the summer this number is increased by eight additional collectors on the crew. Two people are on duty at the office at all times, and they will gladly give any information or adjust any complaints which may be entered.

Few teachers realize the expense that is involved in the collecting and preparing of marine animals. Many, we are certain, believe that it is only necessary to walk along the beach, pick up the specimens and put them into formaldehyde. Nothing could be farther from the truth. The entire collecting region must be carefully explored in order to find sources for the various forms, and at times it is necessary to take long trips to secure them. To do this exploring and collecting, boats costing several thousand dollars must be employed. These must be provided with pumps, so that the specimens may be kept in running sea-water while they are on board. Then, when they are brought to the laboratory, many of them must be put through long and complicated processes to be properly narcotized, expanded and preserved. The pumps and tanks needed to supply the laboratory with running sea-water are very expensive, and far beyond the means of any individual who may be trying to collect without equipment.

The Supply Department has this year issued a new biology catalogue, which will be given out upon request, and which lists the complete stock of preserved and living material. This may be obtained at the office. The prices of materials have been greatly reduced, and special attention is being called to the grading of the sizes in materials which have been arranged for the convenience of the customers.

Our Department is, without doubt, the best equipped marine collecting station in the United States, if not in the world. Its collecting equipment, consisting of boats, fish traps, seines, dredges, tangles and laboratory facilities, are of the very best, and represent a great investment. Its staff of collectors and preparators has had many years of experience. It is these advantages in the collection and preparation of marine specimens which explain, to a great extent, the uniformly good quality of the preserved material furnished by the Supply Department.



NATHAN AUGUSTUS COBB

To the wide circle of friends of Dr. Cobb the knowledge of his death came as a distinct shock, and remains as an abiding sorrow. The loss to the world through the removal of such an active and constructive mind as his is beyond computation. Especially is such a loss acute when, as it does in this case, it means the calling away from the field of action of one of the world's leaders in humanity's warfare against hitherto unsuspected because largely unseen foes.

Dr. Cobb, born June 30, 1859, in Spencer, Mass., taught in the public schools of Spencer, where he introduced what is now called nature study; entered Worcester Polytechnic Institute in the winter of 1878-9, specializing in chemistry, and was graduated in 1881 with the degree of B.S. His graduation thesis was entitled "Notes on Miller's System of Crystallography" and was entirely mathematical. In it Miller's conclusions were demonstrated by analytical geometry instead of spherical trigonometry as Professor Miller had done. The thesis was submitted to outside judges, Professors B. K. Emerson of Amherst and E. S. Dana of Yale, who confirmed the opinion of the local judges that it was a thesis of extraordinary merit. Professor Dana suggested that the thesis be sent to Professor Groth of Germany, for publication in the *Krystallographische Zeitung*. The thesis was published for the first time in 1931.

After graduation from Worcester he taught in Williston Seminary for six years. While at Easthampton he engaged in outside study. He prepared and published a flora of the vicinity, in which work he became acquainted with and profited by the council of Professor Asa Gray of Harvard, and Leo Lesquereaux. He also was assisted in improving his geological knowledge by Professor Emerson. Dr. Cobb told me last summer that he had wished to study at Johns Hopkins University, but had passed the age limit for a scholarship by a few months when his application was made.

In 1887 he went with his family, who, it should be stated, accompanied him in all his wanderings, to Jena, Germany, where in the following year he received the degree of Ph. D. While in Jena he took the courses in zoology under Heackel and Lang; in embryology under Oscar Hertwig, and botany under Stahl. He was able to pass his examination in geology through knowledge obtained in the preparation of his Worcester thesis and his geological studies prosecuted at Easthampton.

Dr. Cobb has put it on record that if he were asked to name the parts of his early training that had the most influence in whatever success he may have attained, he should himself give a high place to his early intimacy with a great variety of practical operations. An idea of what these varied experiences were may be glimpsed when it is learned that his father at various times followed the trades of millwright, engineer, carpenter, factory foreman, contractor and farmer, at all of which he was fairly successful. As his father's assistant he was given the opportunity of learning a great variety of work. Thus, he was often left in charge of the wire mill of which his father was foreman. Or he would be left in charge of the farm of 150 acres, with its horses, cows, orchards, garden, wheat, corn, grass, poultry and pigs for weeks at a time while his father was away at work on contracts. He did all this before he was fourteen.

His work for the doctorate was in the field of helminthology. Much of his time, especially in later years, was given to the nematoda, or nemas, as he insisted they should be called. As a result of his investigations, during which he published some 200 books and pamphlets, and is said to have described and named some 1,000 new species of animals and plants there was revealed a world of living forms, before but little known, represented in large measure by free-living and plant-parasitic nemas.

After Jena Dr. Cobb worked a year at the Naples Zoological Station, his appointment there having been made by the British Association for the Advancement of Science.

Of Dr. Cobb's varied experiences in the years which intervened between his departure from Naples and his return to his native land Dr. Hall says:—

> After a year at Naples, Dr. Cobb wished to visit Australia, and as his meagre funds were exhausted he borrowed money from a friend in his Massachusetts home and sailed with his family to Sydney. He had no position in sight, but he had letters of introduction, and his ability and confidence. During his first month in Sydney he spent his mornings in presenting his letters of introduction to persons who might secure a position for him, and his afternoons in microscopical investigations carried out at his residence. At the end of a month he obtained a position with a commercial house, one of his duties being to write advertisements. He carried out this work with his characteristic thoroughness and initiative................He wrote the story of the American watch and undertook to publish a full page advertisement, with illustrations in one of the Sydney papers. No illustrated advertisement had ever been published in the Sydney papers, and the first paper approached on the subject refused to indulge in this novelty. However the Sydney Telegraph agreed to publish the advertisement, and did so at a price which shocked Dr. Cobb's employer. Simultaneously with the publication of the advertisement Dr. Cobb had a jeweler's window filled with the watches, showing some of them running under water. This exhibit drew great crowds and the venture was a financial success.
>
> In 1890, Professor Haswell of the University of Sydney left on a year's leave of absence, and Dr. Cobb was appointed *locum tenens* in his position.
>
> From 1891 to 1898 he was pathologist of the Department of Agriculture of New South Wales. He helped to organize that department and for the last year of this period was also manager of the Wagga Experiment Farm.

At the close of his incumbency at the Wagga Farm Station he proposed to resign his position in New South Wales, where he ranked as senior scientific officer, in order to visit other countries and refresh himself by observation and by contact with scientific men in Europe and America, to bring himself more closely in touch with the state of science than was possible in Australia. There was reluctance at accepting his resignation. As two or more years were required for the purpose and there being no provision for such lengthy leave. Special Cabinet action was taken appointing him Special Commissioner to report on the Agricultural and other Industries of America and Europe, assigning him two and a half years for that purpose, and re-appointing him in advance to re-occupy his position in the Department of Agriculture at the end of his Commissionership.

Dr. Hall's resumé continues as follows:—From

> 1898 to 1901 he was Agricultural Commissioner to the United States and Europe, carrying out extensive investigations on wheat and other things, and then returning to his position of pathologist from 1901 to 1904 . . . .Early in 1905 Dr. Cobb left Australia and went to Hawaii where he remained until 1907. He organized the Division of Physiology and Pathology of the Hawaiian Sugar Planters' Experiment Station of which he was Director. Here he worked on nemic and fungus diseases of sugar cane, and continued his investigations of

free-living nemas. In 1907 he went to Washington, D. C. as Agricultural Technologist in the U. S. Department of Agriculture . . . For some years he was Acting Assistant Chief of the Bureau of Plant Industry, but at all times continued his investigation on nemas, and under the Reclassification Act he was finally given the title of Principal Nematologist.

When one considers the life work of Dr. Cobb as evidenced by his contributions to useful knowledge the title Principal Nematologist assumes not only a national but also a world-wide significance.

But so varied were Dr. Cobb's interests that even if the contributions to science which earned him the title of Principal Nematologist were to be left out of the count, there would still be left more than enough to entitle him to a commanding place among eminent men of science. It is not possible, however, to condense within the limits of this paper an adequate summary of his contributions to agricultural knowledge and technique, covering as it does a wide range of subjects, including, among other things, cereal crops, sugar cane and cotton, the standardization of the latter being an outcome of his work.

Much could be said of his administrative ability and experience. It is sufficient here to call attention to the success which attended him, a foreigner, in Australia, indicating that he was endowed with more than ordinary tact and discretion. He never gave up his American citizenship.

Dr. Hall speaks of Dr. Cobb's originality and ingenuity in devising methods of preventing vibration in the support of microscopes for fine work, of rotating tables with numerous microscopes for convenience in examining and comparing prepared material, of devices for excluding room light and to secure light effects from canvas reflectors adjustable to the position of the sun, of the employment of the polariscope in the study of birefringent granules, and the use of chemical reagents in investigation on the nature of nemic structures. All these varied appliances were in evidence in his laboratories here at Woods Hole, and were being added to and improved from year to year. In the words of Dr. Hall: "He brought to his study of nemas a sound knowledge of chemistry and physics as well as of zoology and technology."

One privileged to work in the same laboratory with Dr. Cobb and his efficient corps of assistants could not fail to be impressed by the exquisite technique and artistic skill that were here marshalled together, not forgetting the delightful spirit of comradship which animated the little group of workers, all of which, in large measure, was derived from the organizing ability and genial personality of the presiding genius of the laboratory.

Those of us who were favored by daily contact with Dr. Cobb at the laboratory of the Bureau of Fisheries can echo unreservedly Dr. Hall's appreciation when he writes:—

> Dr. Cobb was known to a wide circle of scientists throughout the world. He was a member of numerous American and foreign scientific societies, and was a president of the American Microscopical Society, the American Society of Parasitologists, the Washington Academy of Science, and the Helminthological Society of Washington. In the informal and intimate meetings of the Helminthological Society he will be missed acutely, not only because of the interesting facts he brought to its attention, and the stimulating questions he proposed, but because of his personal charm. He combined frankness with courtesy, and an unshaken dignity with a keen sense of humor. He had unusual histrionic ability . . . Not infrequently he wrote delightful verse for these dinners, and at the last meeting of the society before his death he read some charming nonsense about his nemas, written on the interurban on his way to Washington from his home in Falls Church, Va.

It will be seen from the forgoing that Dr. Cobb was by no means narrowed by his devotion to and mastery of a specialty. Many examples showing the mirror-like quality of his mind as a reflector of nature could be cited. Thus, there are many who will recall that delightful lecture whereby, with the aid of most ingeniously contrived camera studies we were admitted to the intimate daily life of a family of blue jays.

All who knew Dr. Cobb intimately join wholeheartedly in the sentiment with which Dr. Hall, in restrained, but movingly eloquent words, concludes his tribute to his and our friend:—

> On June 4, 1932, Dr. Cobb was in Baltimore, Md., having his annual physical examination. From early life he had had some heart irregularities, probably the sequalae of scarlet fever when he was about two years old, and this condition necessitated these examinations and some treatment. At 9.00 P.M. he was in bed reading and apparently feeling well and comfortable. When the nurse entered the room a short time afterward he was dead. The passing of this able scientist and dear friend is an occasion for regret and sorrow, and we who knew him shall miss him greatly. But those regrets and sorrows are for ourselves, not for our friend, for there is no better alternative in leaving life than to go quickly and while physically fit and mentally unimpaired after a long life of constructive achievement and ap-

preciative friendships. To the wife who followed him throughout his wanderings and shared his hardships, and to the children who have loved and honored him, we extend our sympathy. The tall figure has gone from us, and we shall see no more the intellectual face with its crescentic monocle and the smile for which we looked, but the memory of the man is pleasant and abiding. In no uncertain sense he remains with us and will long remain with us. —*Edwin Linton.*

(I am indebted to Miss Margaret V. Cobb for data relating to her father's life and work, and to Dr. Maurice C. Hall, who has kindly placed at my disposal the manuscript of an obituary note which he has prepared for the "Journal of Parasitology", with liberty to draw from it anything that I can use.)

BOOK REVIEW

Humoral Agents in Nervous Activity with Special Reference to Chromatophores. G. H. PARKER. 1932, x plus 79 pp. Cambridge University Press.

During the last decade physiological evidence has accumulated to indicate that a chemical factor bridges the gap between the terminals of autonomic nerve fibers and the cells of autonomically innervated glands and muscles. The work of Otto Loewi, of Brinkman and van Dam, of Finkelman, and of others has shown quite conclusively that when these tissues are isolated and then stimulated or inhibited through their nerves they give off to perfusates substances capable of reproducing sympathetic or parasympathetic effects in other organs. Any doubts as to whether this sort of thing occurs in the unanesthetized mammal with circulation intact have recently been dispelled, at least with respect to the sympathicomimetic substance, by Cannon and his collaborators, especially Bacq and Rosenblueth. The question that now arises is whether these active substances actually represent the means whereby the nerves act on their respective effector cells. If they do, a secretory process must occur somewhere in the region of the neuro-myal junction. It has long been known that adrenin secreted into the blood as a result of preganglionic sympathetic discharge to the adrenal medulla will act generally on sympathetically innervated organs quite independently of their innervation. May it not be that postganglionic sympathetic impulses arriving at an effector organ induce there a local production of adrenin which in turn stimulates or inhibits as the case may be? Certain it is that an adrenin-like material, Cannon's "sympathin" or Loewi's "accelerator substance," is given off from the effector organ and it remains to determine its precise origin.

In this little book which represents the substance of a lecture given at the University of Cambridge in May, 1930, Professor Parker discusses this question of neurohumoralism in general. For his thesis he has invoked in particular a phenomenon to the elucidation of which he and his students have made notable contributions. Although color changes in animals have excited the interest of naturalists from the earliest times it has been only with the comparatively recent advent of experimental biology that any real analysis of the mechanism of cutaneous pigmentary changes has been made. Professor Parker has here outlined the more important facts now known about chromatophoral control, and it is the opinion of this reviewer that he has given the best general treatment of the subject that is available. Nowhere else can one find a presentation as broadly comprehensive or so refreshingly free from wrangling over what are, after all, rather minor differences of observation and opinion. Dr. Parker points out the curious anomaly that while the chromatophores of teleost fishes and reptiles are either wholly or predominantly managed by nerves, those of the intermediate group of cold-blooded vertebrates, the amphibia, are controlled by a humoral agent of *hypophysical* origin. And the amphibian has its counterpart among invertebrates in those crustacea which exhibit color changes. There again internal secretions seem to be the sole factor. But in each of the color-changing groups neural processes in the eyes condition the process of internal secretion or of nervous discharge to the chromatophores. Apropros of this fact Dr. Parker suggests that fundamentally the two modes of control are the same. He is inclined to regard the difference as consisting in the distance of the site of secretion from the chromatophore and he strongly urges the view that in the case of the so-called direct nerve control there is secretion of hormone by the terminals of the chromatophoral nerve fibers. If supported by sufficient experimental evidence this hypothesis would become a generalization of major importance and one would speak of *neurohumoral* instead of neuro *and* humoral control. Dr. Parker certainly brings forth facts and probabilities favoring his contention, but it is clear that direct proof of secretion by chromatophoral nerve terminals is still very scanty.

In a final chapter the rôle of neurohumoral agencies in the activities of receptors and synapses is discussed. The question of secretory activity at the synapse has been a subject of prime interest ever since Sir Charles Sherrington suggested

(Continued on Page 68)

The Collecting Net

A weekly publication devoted to the scientific work at Woods Hole.

WOODS HOLE, MASS.

Ware Cattell .... Editor

Assistant Editors

Florence L. Spooner   Annaleida S. Cattell

Vera Warbasse

The Beach Question

II

Recently the following notice has been placed on the post at the lower eend of the fence which separates the good beach from the poor one on the Bay Shore:

THE BEACH BEYOND THIS FENCE
IS PRIVATE
PLEASE DO NOT TRESPASS

The fence which supports this message is standing in the water at mean high tide.

It is understood that the property owners on the Bay Shore Beach contend that it is not legal for an individual to walk on the beach between the high and low water marks for the purpose of getting from one point to another. They admit however, that "Persons may enter upon such flats to exercise the right of fishing."

So far as we know, one can be fishing without catching fish. It has been suggested that The Collecting Net rent fishing poles to those individuals who want to walk along the "private" beach, turning the proceeds realized from the enterprise over to its Scholarship Fund.

A Correction

In its first number The Collecting Net printed a brief note concerning the difficulties which the Island Airways had with one of their planes when they first initiated their service. It seems evident that it was not correct, and we wish to express our apologies for inaccurately reporting the situation.

The seaplane made a forced landing through no fault of the Island Airways. The plane had just been returned from one of the most prominent Boston aviation concerns where it had been subject to a major overhaul. Machines receiving this extensive treatment are considered practically equal to new ones. However, in this particular case the head mechanic forgot to insert the cotter key which holds the timing gear in place. The gear slipped which upset the delicately-timed mechanism, and the engine refused to function properly. In other words the forced landing was caused by *minor* engine trouble, instead of a broken connecting rod as our contributor reported. Further, the approximate location of the plane was known within twenty minutes. The pilot made a landing on Muskeget Island, walked to the lighthouse nearby and reported by telephone to his headquarters.

We learn from President A. D. Chandler that there never has been an attempt to withhold information concerning any difficulties that they may have had, and that the officers of the Company stand reaedy to give out complete and unbiased information at all times.

The Directory

We have made the directory supplement in this number as complete as possible. Directory cards which were completed and left at our office or in the Brick Building before Saturday morning at 6:45 have been included. In our directory this year we are printing only the names of the scientific workers who are actually in attendance at one of the laboratories at the time the material must be placed in the hands of our printer. Even though all the evidence seems to indicate that they will come a day or two later, and the needed information known, we have adopted the general policy of not including names of individuals in the directory unless they have personally filled out a card after their arrival in Woods Hole.

BOOK REVIEW

(Continued from Page 67)

some years ago that chemical factors lie at the basis of central excitation and inhibition. In this section of the book one finds the matter considered largely on the basis of the segmented "giant fibers" of certain invertebrates.

Any biologist at all interested in the physiology of the nervous system, in pigmentary alteration or in endocrinology will find this book instructive and exciting. And any such reader who possesses the gambling instinct will take the obvious tip and lay his money on the idea that humoral factors are going to play an ever increasing rôle in our understanding of nervous mechanisms. —*Philip Bard.*

CURRENTS IN THE HOLE

Date	A. M.	P. M.
July 10	9:57	10:29
July 11	10:51	11:28
July 12	11:46	——
July 13	12:27	12:43
July 14	1:27	1:39
July 15	2:25	2:37
July 16	3:22	3:29
July 17	4:15	4:24

ITEMS OF INTEREST

Dr. W. J. V. Osterhout sailed for Europe on July 1. He will attend the Fourteenth International Congress of Physiology in Rome.

Dr. Edward Uhlenhuth will not be in attendance at the laboratory this summer, because he has taken a trip to Europe.

Dr. P. W. Whiting, who has been a member of the Department of Zoology at the University of Pittsburgh since 1928, has been promoted to a full professorship.

Dr. Edgar P. Jones who spent the summers of 1930 and 1931 at the Laboratory, has been appointed instructor in zoology at the University of Pittsburgh for the approaching academic year. He has just received his degree from the Department of Zoology in this institution.

Dr. W. M. Stanley who has been working in the Department of General Physiology at the Rockefeller Institute for Medical Research is transferring his work to the Department of Plant Pathology in the same institution at Princeton.

Dr. Edgar van Slyke, who has worked at the Marine Biological Laboratory for several years, received his Ph. D. in zoology from the University of Pittsburgh in June. Next year he will be a fellow in anatomy in the School of Medicine at the University of Maryland.

Dr. Ben H. Hill, formerly Professor of Biology in High Point College (North Carolina) has been appointed instructor in histology in the Dental School of New York University.

Miss Sarah W. Chapman has been appointed assistant in physiology at Vassar College.

Mr. M. Herbert Eisenhart, vice-president and general manager of the Bausch and Lomb Optical Company, has been appointed a member of the board of the Massachusetts Institute of Technology.

Dr. James W. Mavor gave a paper in the symposium on the biological action of X-rays which was held under the auspices of the American Association for the Advancement of Science on June 24. His subject was the "Effect of X-rays on Germ Cells and Heredity."

Dr. G. H. Parker contributed an article entitled "The Passage of Sperms and Eggs Through the Oviducts of the Rabbit and of the Human Being with a Consideration of Sampson's Theory of Hemorrhagic or Chocolate Cysts" to the May number of the *American Journal of Obstretrics and Gynecology.*" *

GLEANED FROM THE BULLETIN BOARD

College students with experience desires position as laboratory assistant. Communicate with Vera Warbasse. Phone 726. P. O. box CC. Woods Hole.

Laboratory Technician. Experience at Harvard Botanical Laboratories. Maud Gustafson, c/o McInnes, Millfield Street.

Position Wanted as research or laboratory assistant. Preferably in physiology. F. N. Craig, Rutgers '32. Kahler House.

Manuscript typing done by Miss Nielson. Inquire at Supply Department.

Typewriting or stenographic work. Neat and accurate. Apply to Mrs. Edwin Laug, New Dormitory, Room 302.

Tutor or companion for boys, aged 6-15 years. By the hour, day or season. Highest local and out-of-town references. T. S. Perry Griffin (Harvard, 1913). c/o George Griffin, High Street, Woods Hole. Telephone 774.

For Sale. At the supply department, Reprint of "Physical and Chemical of the egg of the Sea Urchin, arbacia punctuata," by Dr. E. Newton Harvey.

Do you like to learn Spanish: Mexican student will exchange Spanish for English. E. Beltran, New Dormitory, Room 203.

Catboat for rent. By hour $1.00. By day $5.00 By week $10.00. Vera Warbasse. Phone 726. Collecting Net Office, 8:30-12:30 A. M.

(Notices of this kind will be inserted in THE COLLECTING NET without charge for members of any one of the three scientific institutions in Woods Hole).

* Limitations of space made it almost necessary to print an abstract of the paper instead of its title.

DIRECTORY SUPPLEMENT

MARINE BIOLOGICAL LABORATORY
Investigators

Anderson, Stella B. secretary "Industrial and Engineering Chemistry." Br 203. D 205.
Atlas, M. asst. zool. Columbia. Br 314. Dr 5.
Ballard, W. W. instr. zool. Dartmouth. Br 217k. Dr.
Barnum, Susie G. secretary Nat. Res. Council Br 120. Hi.
Bigelow, R. P. prof. zool. and parasitol. Mass. Inst. Tech. Br 334. Cross.
Bissonnette, T. H. prof. biol. Trinity (Hartford). OM 26. D 108.
Brown, D. E. instr. phys. Bellevue Med. Br 214. Metz, Hyatt.
Budington, R. A. prof. zool. Oberlin. Br 218. Orchard.
Chen, T. T. instr. zool Pennsylvania. Br 220. Elliot, Center.
Cheney, R. H. chairman biol. dept. Long Island. OM 45. D 208.
Church, C. F. asst. instr. pedriatics. Pennsylvania Med. Br 126. Winslow, Quissett.
Clark, Eleanor L. vol. invest. Pennsylvania Med. Br 117. West.
Clark, E. R. prof. anat. Pennsylvania Med. Br 117. West.
Cole, E. C. assoc. prof. biol. Williams. OM 28. D 204.
Copeland, M. prof. Bowdoin. Br 334. Gardiner.
Corson, S. A. grad. res. asst. phys. Pennsylvania. Dr 7.
Darby, Callye Nat. Res. Council. Br 120. H.
Dawson, A. B. assoc. prof. zool. Harvard. Br 312. A 202.
Donaldson, H. H. mem. Wistar Inst. Br 115. Buzzards Bay.
Driggs, M. F. Cornell Med. Br 222. Ka 23.
Eyre, Sarah W. res. asst. biol. Long Island. Lucke, Minot.
Fleisher, M. S. prof. bact. St. Louis. Br 304. D 112.
Gerard, R. W. assoc. prof. phys. Chicago. Br 309. D 313.
Gordon, Gladys secretary. "Industrial and Engineering Chemistry." Br 203. Nickerson, Millfield.
Henshaw, Christine T. asst. biophysicist. Memorial Hosp. (N. Y.) Br 311. D 209.
Henshaw, P. S. biophysicist. Memorial Hosp. (N. Y.) Br 311. D 209.
Hoadley, L. prof. zool. Harvard. Br 312. A 308.
Hotchkiss, Margaret instr. bact. N. Y. Homeopathic Med. Wilde, Gardiner.
Howe, H. E. editor "Industrial and Engineering Chemistry." Br 203. Tinkham, West.
Howe, Mary mm. edit. "Industrial and Engineering Chemistry" Br 203. Tinkham, West.
Howland, Ruth B. assoc. prof. biol. New York. Br 1. Young, Middle.
Irwin, Marion S. ed. "Biological Abstracts." Libr. Hilton, Water.
Jahn, T. L. fel. zool. Yale. Br 123. Gray, Buzzards Bay.
Jones, N. sc. illus. Br 211. Hall, Water.
Kaufmann, B. prof. bot. Alabama. Bot 4, Spaeth, Whitman.
Keyes, D. B. prof. ind. chem. Illinois. L 23. Grinnell. Bar Neck.
Kiess, Mary D. Pennsylvania. Br 217 h.
Lacaillade, C. W., Jr fel. Rockefeller Inst. Br 208. Nickerson, Millfield.
Levy, M. instr. chem. New York. Br 310. F. Wilson.
Lundstrom, Helen M. res. asst. chem. Children's Hosp. (Phila.) Br 109. Wi.
McGraw, Myrtilla H. secretary. Nat. Res. Council. Br 120. Hi.
McGregor, J. H. prof. zool. Columbia. Br 301. Elliot, Center.
Mihalik, P. assoc. prof. anat. Budapest (Hungary) Br 107. 310.
Modell, W. W. asst. anat. Cornell Med. Br 318. McInnis, School.
Mosley, J. E. Harvard. Br 315. Breakwater, Bar Neck.
Newton, Helen mm. ed. "Industrial and Engineering Chemistry" Br 203. Veeder, Millfield.
Parkinson, Nellie A. asst. "Industrial and Engineering Chemistry." Br 203. Young, West.
Pierce, Madeline E. instr. zool. Vassar. Br 217c. Kittila, Bar Neck.
Rawles, Mary E. res. asst. zool. Chicago. Br 224. Mendel, High.
de Renyi, G. S. assoc. prof. anat. Pennsylvania Med. Br 125. D 217.
Robbins, W. J. Missouri. D 317.
Sayles, L. P. instr. biol. Col. City N. Y. OM 25. D 214.
Schmieder, R. G. instr. zool. Pennsylvania. Br 220. Sylvia, Buzzards Bay.
Schrader, F. prof. cel. biol. Columbia. Br 330. D 309.
Schrader, Sally H. instr. zool. Sarah Lawrence. Br 330. D 309.
Saeger, A. Nat. Res. Fel. biol. McLeish.
Shapiro, H. asst. biol. Princeton. Br 110. Dr 10.
Smith, B. A. grad. zool. Pittsburgh. Rock 7. McLeish, Millfield.
Stanley, W. M. asst. plant path. Rockefeller Inst. Br 209. Howes, Water.
Steinbach, H. B. instr. zool. Pennsylvania. Br 111. Elliot, Center.
Taylor, Georgiana M. grad. zool. Pittsburgh. Rock 2.
Taylor, W. R. prof. bot. Michigan. Bot. 24. Whitman.
Tittler, I. A. asst. zool. Columbia. Br 314. Dr 10.
Wenrich, D. H. prof. zool. Pennsylvania. Br 220. D 215.
Willier, B. H. prof. zool. Chicago. Br 224. Mendel, High.

STUDENTS

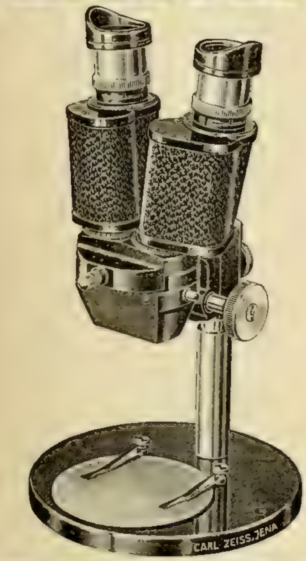
Bradbury, Hester A. grad. Duke. emb. Chambers, Gardiner.
Hussay, Kathleen L. fel. zool. Ohio Wesleyan. emb. Hilton, Main.

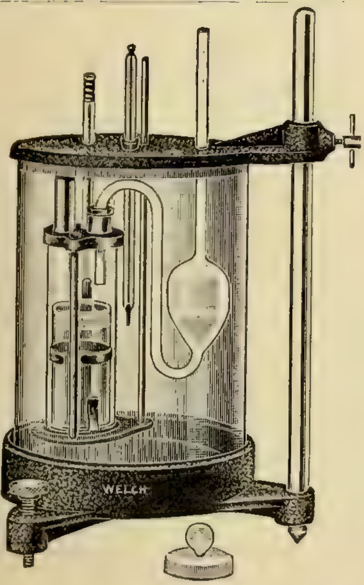
WOODS HOLE OCEANOGRAPHIC INSTITUTION

Redfield. A. C. prof. phys. Harvard. 103. Park.
Seiwell, Gladys E. Brown, 212. Taft, Minot.
Seiwell, H. B. investigator oceanog. W. H. O. I. 212. Taft, Minot.
Waksman, S. A. prof. soil. microbiolog. Rutgers. 201. (Penzance Point).

SUPPLY DEPARTMENT

Sither, J. A. Kimball Union Acad. collector. Dr.


CARL ZEISS, JENA


WELCH

THE WOODS HOLE LOG

THE TRAIN DERAILMENT

The engine and forward wheels of the first car on the 7:15 A. M. train for Boston left the rails this morning shortly after leaving the Woods Hole station. No one was injured. A wrecking crew from Taunton made quick work of clearing the tracks so that the afternoon trains could leave and arrive on scheduled time.

Mr. Vallis, the agent, responded to the emergency by having Hoit Savery meet the incoming morning train at Falmouth and transport the mail, baggage, express, and milk over the road to Woods Hole so that the steamer "Naushon" was able to depart for the Islands only slightly behind her scheduled leaving time. According to *The Falmouth Enterprise* passengers for Boston were transferred to a freight train and taken to Buzzards Bay where they made connections with a passenger train.

Quite a crowd gathered to watch the wrecking crew put the engine back on the tracks, and it was necessary for two policemen to direct traffic on the road opposite the tracks where the derailment occurred.

RESULTS OF THE RACES

The Woods Hole Yacht Club held its first race on Tuesday, July 5, at 4 P. M. The winners were: Louise Crane in the *Scampi.* (Buzzards Bay Knockabout), Morris Frost in the *Windward* (a Cape Cod Knockabout), Albert Woodcock in Captain Iselin's red-sailed dory, and Agnes Warbasse in Janet Blume's catboat the *Dinny.* The first races in large boats ever held by the Woods Hole Yacht Club in its 35 years of existence were held on Wednesday, July 6, in Buzzards Bay. Joseph Russel won in the S boat class in the *Aminta.* Henry Kidder won in the *Whistle Wing.* Eric Warbasse won in the *Tern* in the Quissett handicap class.

The fire engines seem to be having a difficult time. The weather has been particularly dry however, which may account for the unusual number of fires. Tuesday the engines were called out to the Park's estate for the second time, the first one being a false alarm. This time a Chevrolet roadster belonging to Frank Park caught on fire. A short circuit ignited fluid that was being used to clean the car. The fire was put out quickly and the car after a few repairs will be quite alright.

Since leaving here last September, Mr. Shaw has been working for W. T. Grant Company. He is now in Holyoke, Mass. after having spent several months in Dallas, Texas and in Charlotte, N. C.

THE FIRE ON THURSDAY

Dr. L. V. Heilbrunn left Woods Hole early Thursday morning without the faintest suspicion that anything disastrous would occur while he was gone. But about three o'clock that afternoon, clouds of smoke poured out of his summer home on Gardiner Road which he is renting from Dr. Schramm. Mrs. Heilbrunn had been away for a short while, and when she came back she saw smoke issuing from the cellar in various places. The wind was blowing pretty hard and it soon carried the flames to the outside walls and the roof. The prompt response of the Woods Hole Fire Department and their efficient work saved the wooden structure—and little damage was done either by fire or water.

The cause of the fire is not known. However, it is believed that the woman who was cleaning the house for Mrs. Heilbrunn may have dumped some ashes containing smouldering charcoal from the open fireplace into the trash barrel in the cellar.

RESCUED AT SEA

The Fourth of July week-end brought busy times for the Coast Guard Station at Woods Hole Three cases of assistance were reported, the first occurring on July 1. On that day the yawl "Pamaho", owned by Stanley Cobb of Cotuit was found stranded on East Buck Island off Naushon. The C-G 910 with Daniel Dorey, C. B. M. in charge, pulled her off and brought her in.

On July 3, the sloop yawl "Mike" was reported stranded on Crest Ledge, Woods Hole. The C-G 910, in charge of Carl Forst, C. B. M. went out to her assistance. The boat is owned by Dr. Kenneth A. Cole of the Marine Biological Laboratory.

The yawl "Lady Luck", owned by Miss Mary Love, of Woods Hole, was located off Nobska Point in a sinking condition on the Fourth. The C-G 910, with Harry F. Ademek, C. B. M. in charge, went out and towed her in.

Commander Patch of the Coast Guard has gone away for a month's leave of absence.

Gene Tunney, former heavyweight champion of the world, arrived on the "Cape Codder" Saturday morning, July 2, and took the 8:20 boat to Oak Bluffs to attend a wedding at Edgartown. Mr. Tunney chartered one of the Island Airways' seaplanes to fly back to Connecticut.

Mr. Joseph O. Shaw, who for the past five summers sold tickets at the steamboat wharf, expects to arrive in Woods Hole about July 13 for a short vacation.

(Other pages of the Woods Hole Log will be found on pages 74 and 78)

THE WOODS HOLE LOG

"SHEEPING" ON NAUSHON

Those who have been on Naushon have undoubtedly seen the numerous sheep grazing there. Twice a year, in June and in September, all these sheep are rounded up and corralled in a pasture at Tarpaulin Cove, near the Sailors' Home. Here they are counted, sheered in June and sometimes given medicine to protect them from disease.

This June 1200 sheep were rounded up and treated. The process of collecting all the sheep on the islands is colloquially called "sheeping." Although it has been doubted, there does exist a definite technique in this "sheeping" process. Each family of Forbes on the island invites its house guests who are capable and willing to participate. At eight o'clock the people meet on horseback in pairs, five or six groups in all. The island is divided into sections by numerous stone fences, one region at a time being "sheeped". The groups form a straight line, yelling and driving forward. The sheep are ahead of them, and are soon driven over a gate to the next pasture. Then that pasture is "sheeped" and all the sheep are soon collected. Very often a "wooley" gets too tired to run any further and must be tied and carried across someone's saddle much to the discomfort of the rider and the annoyance of the horse. When frisky sheep break away there is great excitement, for they have to be chased and often drop from sheer exhaustion and must too be carried.

About thirty people "sheep" each day. It takes a week to do one whole island, riding four horses in the morning and three in the afternoon. One day is spent on Penikese rounding up the sheep. Because that island has no connection with Naushon, the horses cannot be transported to it; therefore sheeping is done on foot, by running after them. This job is the most unpopular part of the work.

The first Penzance Forum met on Sunday, July 3 at the residence of Dr. and Mrs. J. P. Warbasse. About twenty people came over to the point to enjoy the sun and view as well as the discussion. Among the subjects under discussion were the coming presidential election, the possibility of a dictatorship, and free trade. Everyone present took part in the discussion, eeither by giving their views on the subject, or asking questions. It was decided to have a speaker to lead the discussion every Sunday. He will talk for about half an hour, and for the following hour there will be an informal discussion in which everyone will participate.

AT SILVER BEACH

During the past week, the theatre-going residents have been terrified by the possibility of the existence of a supernatural ghost train. "The Ghost Train" as produced by the Theatre Unit does not attempt to solve a murder as most plays of its type do, but tries to explain the presence of a ghostly train which haunts a small Maine town. You discover during the last ten minutes that the train is run by a gang which smuggles cocain, morphine and liquor into the country.

The play itself is not as sensational as are most mystery plays. Nevertheless, the Theatre Unit players kept the pace going at a quick tempo. Bretaigne Windust, as an apparently brainless Englishman who is later discovered to be the detective, does this difficult part extremely well. The part of the girl who takes dope, played by Barbara O'Neil, seemed unnecessary and a bit overdone. I do not believe I have ever seen such an excellent bit of characterization as was done by Mildred Naturch as an intoxicated spinster.

The company made as much as it reasonably could out of the play they produced, though a better choice might have been made.

"Berkeley Square" will be the third play on this summer's production list, beginning on Monday, July 11, and continuing for a week's run.

"Berkeley Square" is familiar to many theatre-lovers as one of the most provocatively beautiful plays produced on the twentieth-century stage. Basing its theme on the fantastic hypothesis that time may be, in a sense, recurrent, the play presents a fascinating human experience. It takes a twentieth-century American, Peter Standish, and places him in the setting of eighteenth century London. Captured by the charm of this period, Standish finds himself literally transported to the heights of that atmosphere. He discovers himself in the society of George Third's London, yet he sees that period with the eyes of a modern American. To him, the future has become the past, and the past the future. Falling in love with a maiden of that age, he sees himself in the clutches of fate—for in his own words," what has been, will be." —*Vera Warbasse.*

The Woods Hole Golf Club gave its first dance on Saturday night, July 2. This dance was the first of a series which will be continued throughout the summer, and which will be open to members and their guests.

(Other pages of the Woods Hole Log will be found on pages 72 and 78)

THE WOODS HOLE LOG

THE WORK OF THE COAST GUARD

(As learned from an interview with Commander Roderick Patch)

Perhaps it is not generally known that the United States Coast Guard, a unit of which is based at Woods Hole and patrols the waters of Martha's Vineyard, Nantucket Sounds and the adjacent waters, was established in 1790 during the first congress of the United States, in Washington's first administration. The original law assigned to this service the duties of "protecting the Harbors and Coasts of the United States and the shipping thereof." It also assigned it as an additional peace time duty, that of the enforcement of the Customs Revenue Laws at sea. Since that time, 26 new duties have been added to the peace time work of the service. The Coast Guard as it is now known originally did not have a name, and has been variously called during its existence as the United States Marine Service, The Revenue Marine and the Revenue Cutter Service; it was not until 1915 that it received its present name of the United States Coast Guard.

As an example of the peace time work of the service, and as an idea of the volume of work it accomplishes, the following records, taken from the Base Eighteen files for the period from July 1 to October 7 of last year, reveal that there were 77 cases of assistance rendered. And the value of the vessels assisted, as estimated by their owners or masters, was around four and one half million dollars, while the cargo of these boats approximated nearly another million dollars.

The United States Coast Guard equipment has been kept up to the most approved and latest standards. For instance, they have, together with all the other stations, a very complete communication service, including 15,000 miles of telephone and telegraph lines. Their radio service connects up all the patrol vessels to their bases, other ships and all the major traffic stations. In addition, there is a cable service. In this way, all the United States Coast Guard Stations, ashore and afloat, and a great many of the lightships and lighthouses are directly linked up to the commercial telephone system, so that in case of a grave or imminent disaster, communication can be had directly with the communication center. This system is, primarily of course, for the sake of the protection of shipping, but its value is inestimable in war time.

In conjunction with all these developments, there is a still more recent one which, according to Commander Patch, promises well for the future. That is their aviation reporting system, whereby planes flying along certain known routes, can be watched more or less carefully, and if and when necessary, aided by the Coast Guard, in time to save life and most likely property also. It is being used now with much success in connection with the route followed by planes flying from New York to the South, and it is expected it will soon extend to other regular coastal airplane lines.

Another service they now render in connection with aviation is in being able to rescue small parties of fishermen in trouble at sea. These planes are specially constructed to land on very rough water, and can accommodate in the larger flying planes twelve passengers besides their own regular crew of four men. Each of these planes have a complete radio sending and receiving set, and other modern safety devices.

While on the subject of equipment, perhaps it is not generally known that the latest cutters used by the Coast Guard are capable of cruising from here to Great Britain and back without re-fueling, and that they have a displacement of two thousand tons. Their speed is good for a sea-going vessel —about 12 knots—.The work on the small 75-foot boats is not as exhilirating at times as it might seem from mere observation, since, in rough weather, sleeping on board is practically impossible. For this reason, the boats do not stay out for more than three days at a time in bad weather. However, a constant patrol is maintained.

On June 23 the Coast Guard Base at Woods Hole sent out six of their boats to assist in patrolling the Yale-Harvard races at New London, where undoubtedly, a bit of pleasure will be combined with their work. —F.L.S.

THE YACHT RACES

The Quissett Yacht Club held its first race on Saturday, July 2. It was an extremely windy day, and the waves in the bay were very high. All the boats were reefed, which is an unusual thing to do. The race is usually called off if there is sufficient wind to warrant shortening the sail. One of the knockabouts could not be handled in the heavy gale, and sank. Only the air tanks kept the boat from going to the bottom. Usually nine or ten knockabouts race, but on Saturday only three finished the race. There were 5 or 6 "S" boats which did finish. On Monday, July 4, there was a special race with a separate cup. The "Qs" raced the "Qs", the Manchesters raced the Manchesters, and the Eastern Yacht Club's raced the Eastern Yacht Club boats. In the general races on Saturday, all these boats raced together with handicaps for the larger ones.

The first race of the Woods Hole Yacht Club was scheduled for Monday afternoon, July 4, but due to the strong wind and the inexperience of the racers, the race was postponed.

(Other pages of the Woods Hole Log will be found on pages 72 and 74)

The Collecting Net

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VISCOSITY CHANGES AND MITOTIC CHANGES IN CLEAVING EGGS

DR. HENRY J. FRY and MARK E. PARKS
Washington Square College, New York University

By the use of the centrifuge technique, Heilbrunn showed that the viscosity of Arbacia eggs is low for about five minutes after fertilization, and then rises rapidly as the sperm-aster forms, reaching a peak about twenty minutes after fertilization, the time when the aster becomes crescent shaped. This stage he interpreted as the prophase of the first cleavage figure. Thereafter the crescent-shaped aster persists for about twenty-five minutes while viscosity slowly drops, reaching a low level about forty-five minutes after fertilization (depending on the temperature), a time he thought to be the period of metaphase and anaphase. Viscosity rises rapidly again just prior to cleavage. His conclusions were that viscosity is high at prophase when the mitotic figure is forming, low during metaphase and anaphase, and high again at telophase when (*Continued on Page* 89)

M. B. L. Calendar

TUESDAY, JULY 19, 8:00 P. M.

Seminar: Dr. A. B. Dawson: "The Relative Degrees of Differentiation of the Mature Erthyrocytes of Vertebrates."

Dr. Paul Weiss: "The Factor which Determines the Orientation of the Growing Nerve Fiber."

Dr. G. H. Parker: "Neuro-humoralism."

Dr. R. W. Gerard: "Observations on the Velocity of the Nerve Impulse."

FRIDAY, JULY 22, 8:00 P. M.

Lecture: Professor W. E. Garrey: "Some Aspects of the Physiology of the Heart of Limulus."

THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

DR. REGINALD G. HARRIS
Director of the Laboratory

Since this is the third article that has been written for THE COLLECTING NET upon this subject, I almost feel that it might well be something of an Annual Report. Indeed, it would be wholly appropriate for the Laboratory at Cold Spring Harbor to make an annual report to the biologists at Woods Hole, for the Biological Laboratory exists for biology and for biologists.

Unfortunately, this year the annual reports of nearly all organizations, from railroad companies to universities, seem to carry an inescapable note of sadness, and so, perhaps, it will be excusable, and I hope interesting, if the future of the Biological Laboratory is presented at this time. This, too, is appropriate since biologists at Woods Hole have quite as much reason to be concerned with the future of the Cold Spring Harbor Laboratory, as with its present and past, and since the obligation of the Laboratory to biology and biologists in general

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should, if anything, increase with the passage of time.

What are our hopes for the Biological Laboratory and why do we have them?*

It might be sufficient justification for the existence of the laboratory at Cold Spring Harbor merely for it to be a small Woods Hole. The Marine Biological Laboratory has grown to be a large institution, which, together with the presence of other institutions, makes the scientific population of Woods Hole mount to five hundred or more during the height of the season. It is true that some biologists are not highly gregarious animals, that they are made unhappy merely by a prolonged stay in a concentration of people, whether colleagues or not. Such biologists should have available to them a laboratory where there is not a large number of people. Furthermore, relatively large size, in and of itself, carries with it certain seemingly inescapable disadvantages. Apparently no human institution can become large without the formation within it of smaller bodies, whether parties, sects, factions or cliques. In short, there are disadvantages as well as advantages in the attainment of large size, and hence if the Cold Spring Harbor Laboratory were merely a small Woods Hole Laboratory, it would unquestionably have sufficient justification for existence.

Those of us who, by pleasure, or circumstance, or both, have given long continued thought to the matter, however, go farther than this. Immediately, in the location of the Laboratory at Cold Spring Harbor, we find cause for a different type of development. The location at Cold Spring Harbor strongly invites the development of an all-year biological institute as well as of a summer laboratory, while the location at Woods Hole does not. The third Director of the Biological Laboratory, Dr. Charles B. Davenport, answered this invitation by establishing here, over twenty-five years ago, the Department of Genetics of Carnegie Institution of Washington (then known as the Station for Experimental Evolution of Carnegie Institution of Washington), and later by the establishment nearby of the Eugenics Record Office.

The reasons, which impelled the locating of these all-year research institutions at Cold Spring Harbor, were among those which constantly demanded that the Biological Laboratory should seriously enter upon all-year work. Along with size, this all-year aspect of the work of the Laboratory at Cold Spring Harbor forms an important difference from the Marine Biological Laboratory at Woods Hole. It is this all-year work which we will consider in looking toward the future.

The fact that one of the very first steps which we took in this direction, other than the appointment of a Director to be in residence throughout the year, was the establishment of a laboratory for biophysics, and the selection of a physicist to be in charge of that laboratory, is indicative of our general notions concerning the future of biology.

There are differences of opinion among biologists as to the relative value of biophysics. Some of the more optimistic and gullible look there for the utopia of biological discovery, as, indeed, they or their kind have regarded nearly every new corridor of biological research. We hold no such point of view. We do believe, however, that the history of biology will be similar to that of the continued accumulation of data in every arbitrary division of human knowledge, (1) that biology will become increasingly quantitative in nature and interpretation, and (2) that it will increasingly approach or pass beyond the borderline of other divisions of knowledge.

The first, quantitative biology, is forced upon us, whether we will or not, by the very nature of research. Advance in research is dependent upon the ability to control experimental conditions. The more controllable the conditions of the experiment, the greater the accuracy with which one may prophesy the results of repeated tests. The greater the reproducability of results, the greater the speed with which they are accepted as demonstrated fact. The greater the speed with which facts may reasonably be accepted as demonstrated, the more rapid the advance into new territory, using the points already taken as new bases. In this way, the ability to make use of variables open to experimental control continually increases, and with it the opportunity for the biologist to approach his work from a quantitative viewpoint.

It is also to be expected that biology will increasingly approach or pass beyond the borderline of other sciences. As I have hinted, all divisions of human knowledge are probably wholly arbitrary. As we obtain more information in each of these divisions, we find that boundaries formerly set up for it are wholly inadequate. As an example of this, we need only consider the scope of genetics of a generation ago, and the scope of the same division of biology today. Among larger divisions of human activity, there has long existed the conflict of science and religion, arising

* While the viewpoints expressed herein are given as my own they are, of course, the result of the interaction of my observations and the suggestions and opinions given to me by a number of biologists. For this reason, it would be obviously unfair to mention the names of these biologists, save in cases in which their remarks are definitely quoted.

from the fact that it is almost impossible for one to acknowledge the assumed boundaries of the other. In science, all of this has resulted in a confusion of terminology. There are geneticists who seem to be actually engaged in research in endocrinology; others in experimental embryology; others are primarily cytologists, and so on through the list of biological divisions, including biophysics.

The term biophysics has naturally created considerable speculation as to its desirability, but much of the discussion centering about such questions seems to me to be particularly fruitless. It appears to make no essential difference whether we call it biophysics, general physiology, physiology, or biology, the inescapable fact is that biology is, happily, more and more approaching and passing into the historical domain of physics. This is also true of the relationship of modern biological research to the other exact sciences, mathematics and chemistry. It indicates a coming of age in biology, a fact which all biologists and all biological laboratories will wish to welcome. What "quantitative biology" means is admirably and succinctly set forth in a letter which I recently received from Professor W. J. Crozier of Harvard University. As he says, "A quantitative biology must mean, to mean anything, that the properties of organisms are made known, defined, and within limits understood, by virtue of the manner in which they are quantitatively related to variables under control."

The Biological Laboratory at Cold Spring Harbor is much interested in the advance of such a quantitative biology. In preparation for taking a very useful part in the exploration and exploitation of this type of biology, all-year work in biophysics was begun here in 1928. In our plans for the future, the development of all-year work is envisioned as a further fruition of the point of view indicated by our action of 1928, and an extension of that action to include other aspects of quantitative biology. Thus far we believe that biologists in general will react favorably to our plans, but a more detailed consideration of them is desirable, even though we run the danger of losing along the way, the favorable reaction of some of our colleagues.

If modern quantitative biology necessitates the formation of biophysical laboratories, under whatever name they may appear, does it follow that physicists should be urged to come over into biology to help us, or should we work out our own quantitative salvation? This question is decidedly more complex than appears at first. Off hand one might say that a simple method of immediate procedure would be either for biologists of recognized standing to obtain information concerning physics, or for physicists, who wish to aid in biological research, to gain knowledge of biology, sufficient to make the work of members of either group significant and valuable. But we do not have to speculate about the practicability of such a method. It has already been tried, and while there may have been individual instances of relative success, the results in general have been disappointing to all concerned. Often the physicists work has been unsatisfactory in respect to its biological aspects, while the biologist has been criticized for his lack of discriminating knowledge in respect to physical aspects.

In addition to this frequent lack of approach satisfactory to specialists of both groups, it must be remembered that the clever biologist has lost much time from research on account of the mere necessity of his spending considerable time in the acquisition of information concerning physics. The same, in reverse order, holds for the physicist who conducts biological experiments under his own direction. Even if we wish to be patient and wait for the development of young biologists who will be especially trained to bridge the gap, I doubt very much if even then we shall have a satisfactory answer to the problem which confronts us now, and yet less to the problems which will exist by that time.

It seems to me that the most rapid and most trustworthy progress in this branch of science can reasonably be expected to be made by the establishment of institutes in which research workers in physics who have special leanings toward biological research, and biologists who are unusually appreciative of the possibilities of physics in biology, should work in close harmony, the phyicist being responsible for physical facts and the biologist for biological facts. Just where responsibility will begin and end in any particular case is a matter of small moment, provided both men are congenial, and each man is well informed in his own field. Such a procedure will remove the necessity for a difficult, if not impossible, straddle, and will allow other workers to accept the results of men working in borderline territories, without undue questioning. What is true of physics and biology, in this respect, is probably also true of chemistry and biology, and will probably be increasingly true of these divisions, as well as of mathematics and biology.

There is another aspect of the problem, in which physicists are unquestionably needed in biology, and that is in the discovery of additional facts in physics which are likely to be of particular significance to biology. The advantages of this, and the value of having a first class physicist in the modern biological laboratory, for this purpose, and for consultation, if for no other reasons, are so apparent as not to need further elaboration.

In any case, the developments of an institute in which biologists, physiologists, chemists, physicists and mathematicians will cooperate in the further opening and beneficial use of the vast territory of quantitative biology, is the direction in which our hopes are for the future in respect to the all-year work of the Biological Laboratory. Just how well, or to what extent, our hopes become realized here will depend upon the men selected and the facilities placed at their disposal.

In the actual conduct of the work we expect to elicit, as we have pointed out, the help of specialists in the exact sciences, until such time as it is clearly demonstrated that their presence in a modern biological institute is not desirable. We now believe that the usefulness of such specialists will be increasingly demonstrated, that biology will not only increasingly invade certain parts of the exact sciences, but that we shall find it highly desirable to bring a few captives from the invaded territories back into our own institutes.

Even though such a program may be desirable, why should it be followed at Cold Spring Harbor? There seem to be special reasons why the Laboratory at Cold Spring Harbor in its all-year work should develop such an institute. It has always been the duty of seaside laboratories, even since the establishment of the first station at Penikese by Louis Aggasiz, to take the lead in the fostering of new types of biological study and research, and in acting as clearing houses for information concerning facts and methods. Woods Hole has been notably active in the furtherance of both of these ends, and Cold Spring Harbor has played its part to the best of its opportunity and ability. Originally, the slogan for both laboratories was "study nature not books". Much of the significance of that slogan has now passed into history, but both institutions still have a clear-cut duty to perform in placing before such biologists, as are relatively isolated during much of the year, the opportunities and advantages of modern methods of research. Woods Hole has apparently welcomed its duty in respect to quantitative biology during the summer, but it is obvious that the location of the Marine Biological Laboratory does not favor continued all-year work. At Cold Spring Harbor, however, as we have seen, the situation is quite different. It further happens that certain types of quantitative biological research, particularly those concerned with biophysics, often call for elaborate equipment, and permanent set-ups. It is apparent that such work must be conducted at an all-year laboratory if heavy, unnecessary expense is to be avoided.

In addition to the desirability of establishing such an institute in connection with an all-year laboratory, the small size of the Laboratory at Cold Spring Harbor is a further advantage. It is a well known saying that one can not lift a jelly fish by one tentacle. Similarly it is impracticable to attempt to force faculty members of one or more departments in a university into anything closely approaching a common effort of research. Many administrators have the desire to do so, and may even make the effort. The effort fails to meet with success, probably primarily because the men were not selected for this purpose in the first place. After all, the first end of a university is to instruct the young people who give themselves to its care for that purpose. While research is much stressed in some universities, it must there always remain, by the very nature of things, a secondary consideration.

In research institutions the situation is reversed. There research is the primary end, and it is a relatively simple matter to obtain men who will, from preference, fit themselves into any reasonable program of research which may be adopted. The truth of this assertion may be seen in nearly any research institution in this country or abroad. It is particularly apparent in institutions with geographically widely separated departments, such as Carnegie Institution of Washington. Such research men are eager to establish themselves, under suitable conditions, at the Biological Laboratory, where no member of the all-year research staff is required to give instruction at any time to undergraduates or to graduate students, unless he definitely wishes to do so.

The fact that the all-year staff at Cold Spring Harbor is very small, and that it already is suitable to become an integral part of an institute for quantitative biology, is a very great practical advantage. We are not in a position to be hampered by the just or unjust demands of specialists in other fields, already established on our all-year staff, who may think that a large emphasis on quantitative biological research would be prejudicial to the further development of their departments.

Finally, the establishment of an institute for modern biological research, with special emphasis upon those fundamental problems which invade the historic borderlines of the exact sciences, is itself an experiment. As in all experiments, variables should be controlled in so far as is possible. There have been advanced many reasons why this is peculiarly possible at Cold Spring Harbor. In addition, it should be pointed out that The Biological Laboratory is particularly labile and hence adaptable to this experiment, and that its administration is controlled by a Board of Directors, no two scientific members of which are drawn from the same institution. This tends to insure the fact that, whatever the program adopted, the Laboratory, in its all-year work as elsewhere, is continually committed to serving biology in the largest sense, free from subservience to any other interests.

This is an advantage with which the Marine Biological Laboratory at Woods Hole is also well acquainted, and is, I know, considered one of its most valued heritages.

How will the development of such an all-year aim effect the traditional summer aspects of the work of the Laboratory? My answer to this is: favorably. If any of our summer workers doubted the desirability of establishing here in 1928 an all-year laboratory for biophysical research, I believe that no one who has spent a summer at the Laboratory in the last few years would wish to see the laboratory for biophysics given up. Many of our summer visitors have been definitely benefitted by it, and all have benefitted indirectly.

The Laboratory will continue to welcome biologists to the full extent of its capacity, and desires to continue to function, in so far as it can, for their greatest good.

VISCOSITY CHANGES AND MITOTIC CHANGES IN CLEAVING EGGS

(*Continued from Page* 85)

the egg is cleaving. The phenomena in Cumingia and Nereis eggs were also thought to be in harmony with this interpretation.

Chambers, using a microdissection technique, reached a different conclusion. He maintained that in sea urchin eggs the first rise and fall in viscosity is associated with the formation and disappearance of the sperm-aster, and that the second rise is associated with the history of the cleavage figure.

To investigate fully the relation between changes in the mitotic figure and changes in viscosity (a term used here without consideration of the exact nature of the process) it is necessary to study fixed and sectioned eggs, because the mitotic figure can be seen only vaguely in the living condition. Such a study was made in the present investigation using the following technique. Eggs were centrifuged at intervals of several minutes in order to ascertain the time when viscosity changes take place, as determined by the extent of the stratification produced. The force used for the eggs of each species was the minimum amount necessary to completely stratify all eggs at the period of lowest viscosity between fertilization and first cleavage. The eggs of but a single female were used at any one time; temperature and other conditions were carefully controlled. Whenever an observation was made concerning the viscosity of the eggs, a sample of uncentrifuged eggs was fixed at the same time, for later cytological study in order to find out the mitotic condition predominating at that time, as based on an examination of about seventy-five eggs.

In the case of Arbacia the most important fact to be determined is: what is the crescent-shaped aster which arises about twenty minutes after fertilization? Is it a stage of the sperm-aster or the prophase of the first cleavage figure? To answer this question it is necessary to find out whether the single sperm-aster divides into two to form the prophase cleavage figure, as in Toxopneustes, in which case the exact time when prophase begins is largely a matter of definition, or whether the sperm-aster disintegrates at some stage and the prophase figure arises as a new configuration, as in Echinarachnius, in which case the time of early prophase can be accurately ascertained.

When Arbacia eggs are fixed with ordinary reagents, such as Bouin's or Flemming's, it is very difficult to tell when and how the sperm-aster gives place to the cleavage figure, owing to the fact that the period of the late sperm-aster overlaps the time of origin of the cleavage figure, and the rays are not distinctly fixed. Many variations of technique were tried, and it was found that if eggs are fixed in Bouin's reagent diluted with ninety parts of water, the details of the ray structure in the fixed asters are so distinct that interpretation is a simple matter.

The crescent-shaped aster in Arbacia eggs, present from about twenty to forty-five minutes after fertilization, is the late sperm-aster undergoing slow disintegration from the center outwards. The prophase cleavage figure then arises as a new structure in the area from which the center of the old sperm-aster has disappeared, while remnants of it still persist peripherally. The cleavage figure does not arise by the division of the sperm-aster; the two figures have no continuity with each other as organized astral systems.

Hence in Arbacia eggs, viscosity is low as the sperm-aster forms; it rises rapidly as the sperm-aster increases in size and the pronuclei approach each other; it falls slowly as the old crescent-shaped sperm-aster gradually disintegrates. Viscosity is again low as the cleavage figure forms in prophase, begins to rise at metaphase, and is again high during anaphase and telophase.

In the egg of Cumingia the story is more complex, since there are two polar body astral cycles in addition to the history of the sperm-aster and that of the first cleavage figure. However the facts are in harmony with those of Arbacia eggs. Cumingia eggs are shed at metaphase of the first polar body figure; viscosity is low at this time. Upon fertilization viscosity rises rapidly to a peak and the metaphase stage quickly gives place to that of anaphase. Viscosity begins to fall as soon as the chromosomes reach the spindle-end, and falls rapidly during telophase when the first polar body is formed. It is low during prophase of the second polar body cycle, begins to rise at metaphase, is at its peak at anaphase, and again begins to drop during telophase when the second polar body is formed. This drop proceeds but a short distance, however, when a third rise occurs, associated, as in Arbacia, with the enlarging of the sperm-aster and approach of the pronuclei. Viscosity reaches its peak about the time the pronuclei touch each other and then drops as the sperm-aster disintegrates. As in Arbacia, it remains low during prophase of the first cleavage figure, begins to rise at metaphase, and is, at its peak, at anaphase and telophase.

Preliminary studies of Nereis eggs, while not advanced far enough to be conclusive, indicate that the events there are similar to those in the eggs of Arbacia and Cumingia. In Nereis, the egg is shed in the germinal vesicle stage, when viscosity is high; it drops when the germinal vesicle breaks down. After that the egg goes through four clearly separated astral cycles (first and second polar body figures, the sperm-aster, and the cleavage figure) associated with four cycles of changes in viscosity.

The conclusions from the eggs studied are as follows: First, the number of cycles of rises and falls in viscosity is the same as the number of mitotic cycles. In Arbacia eggs there are two astral cycles—the sperm-aster and the cleavage figure—and two viscosity cycles. In Cumingia eggs there are four astral cycles—the first and second polar body figures, the sperm-aster and the cleavage figure—and four viscosity cycles. In this species the late history of the second polar body figure, and the early history of the sperm-aster overlap each other so as to make difficult the analysis of the viscosity changes accompanying them. In Nereis eggs there are four clearly-separated astral and viscosity cycles.

Second, viscosity is high whenever chromatin is moving, whether as chromosomes on the spindles of the polar body and cleavage figures, or as formed nuclei when the pronuclei are approaching each other during the history of the sperm-aster. Viscosity is also high during cleavage of the entire egg, but not when cleavage involves the formation of the minute polar bodies. In other words viscosity is low when mitotic figures are forming, either during the prophase of polar body and cleavage figures, or the early history of the sperm-aster. At metaphase it is either low or just beginning to rise. At anaphase, when chromosomes are moving, viscosity is always high, as it is during the middle history of the sperm-aster when the pronuclei are moving. At telophase it is high provided the egg is cleaving, but is dropping if polar bodies are being formed; it is also dropping during the late history of sperm-asters.

Third, the proportion of the egg occupied by the mitotic figure is independent of the extent of the rise in viscosity. For example, in Cumingia eggs, the first polar body figure and the cleavage figure are equally large; they are about twice the size of the second polar body figure. Yet the extent of the rise in viscosity associated with all three figures is the same. A similar situation exists in Nereis eggs.

Thus, it appears that the cycles of change in viscosity are in some way associated with mitotic cycles, whether or not these are involved with the movement of the chromosomes and the formation of polar bodies during maturation, or the approach of the pronuclei during fertilization, or the movement of the chromosomes and the cleavage of the egg during segmentation.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 5).

REVIEW OF THE SEMINAR REPORT OF DR. FRY

Dr. Robert Chambers

Professor of Biology, Washington Square College, New York University

Dr. Fry's studies on the cytology of centrifuged eggs bring out several interesting points regarding the relation between the sperm and amphiaster which has been a subject of considerable controversy in the past.

In the sanddollar, the two astral configurations apparently are independent of one another, the amphiaster developing within the non-radial centrosphere area of the degenerating sperm aster.

Another point of interest is his finding that the highest viscosity of the egg cytoplasm coincides with the fullest development of the astral configuration.

I have never advanced the idea that the aster is the cause of the increased viscosity but, on the other hand, that the radiations which appear are an expression of the increased viscosity of the cytoplasm. In eggs caused to develop with artificial parthenogenetic agents the viscosity change is very much retarded. As a consequence, the separation of the hyaline liquid which collects in the center of the aster continues for a long time before the viscosity reaches a state to cause the centripetal flow to produce radiating channels which give the aster its characteristic appearance. The fact that in Cumingia eggs, during polar body formation, the mitotic figure does not occupy the entire egg simply shows that the vigorous streaming to the astral centers is more localizing than in other stages .

Finally, we have to thank Dr. Fry for straightening out the terminology of the various stages after fertilization and thereby bringing into harmony what has hitherto been regarded as discordant views as to the variations in viscosity in an egg after fertilization and during segmentation.

THE ELECTRIC PHASE ANGLE OF TISSUES

Dr. Kenneth S. Cole

Assistant Professor of Physiology, Columbia. University

The alternating current impedances of biological systems indicate the presence of elements having impedances which decrease with increasing frequency of the measuring current. A completely impermeable membrane should have a static capacity with a 90° phase angle and an impedance varying inversely as the frequency. A membrane perfectly permeable to a single ion should show a diffusion polarization capacity with a 45° phase angle and an impedance varying as the inverse square root of the frequency. It can be shown for an electric network consisting of any number of resistances and a single variable impedance element having a constant phase angle that the graph of the equivalent series resistance vs. reactance should be an arc of a circle with the position of the center dependent upon the value of the phase angle. These graphs of bridge measurements of the resistance and reactance of blood (Fricke and Morse), rabbit muscle (Fricke), nerve by (Lullies), frog skin, cat diaphragm, and potato give arcs of circles except at the highest frequencies in certain cases. This indicates that if each of these materials may be considered to have only a single kind of membrane, each has a constant phase angle lying between 45° and 90° which is independent of the frequency for the low and intermediate frequency range.

AN OUTLINE OF MARINE BACTERIOLOGY

Dr. S. A. Waksman

Professor of Soil Microbiology, Rutgers College; Marine Bacteriologist, Woods Hole Oceanographic Institution

The rôle of bacteria in plant and animal life in the sea is still imperfectly understood. It is known that sea water and the sea bottom contain fairly large numbers of bacteria. It is also known that some of these bacteria are capable of bringing about a number of different processes, such as decomposition of organic residues, liberation of ammonia, formation of nitrate, reduction of nitrate, fixation of nitrogen, oxidation of sulfur, precipitation of calcium, precipitation of iron, etc. However, the importance of these processes in plant and animal life in the sea is still a matter of conjecture, due primarily to a lack of systematic investigations dealing with this phase of oceanography. If any phase of biology requires continuous study, it is these lowly microscopic forms of life. One must deal here with living organisms rather than with dead specimens; one must study physiological processes rather than anatomical structure. Certain problems in marine bacteriology have attracted particular attention, especially the problem of denitrification, or reduction of nitrates to atmospheric nitrogen. Both the theory of Drew concerning the precipitation of $CaCO_3$ in the tropics and the theory of Brandt concerning the insufficient plankton development in the tropics as compared with the temperate and arctic regions were based upon this bacterial process. It still remains to be determined, however, to what extent the generalizations made on the basis of the activities of this group of organisms are justified.

The bacteria function in several distinct ways in the sea: (1) By decomposing the dead plant and animal residues and the waste products of these, the bacteria return to the sea and to the atmosphere in a mineralized form those elements from which the algae first synthesized their cell substance, namely the carbon as CO_2, the nitrogen as ammonia, the phosphorus as phosphate, etc. Without this action of the bacteria, the sea bottom would soon be covered with a mass of dead plant and animal debris, and the limited supplies of available carbon and available combined nitrogen would soon become unavailable for further synthesis. (2) By synthesizing new bacterial cell substance and thus actually serving as food for protozoa and other invertebrate animals. (3) By various processes of oxidation, such as nitrification, sulfur oxidation, methane and hydrogen oxidation, iron oxidation, and reduction, (e. g. nitrate reduction and sulfate reduction), the bacteria control the condition of availability of the elements which are so essential for plant and animal life, and frequently the very condition of existence of these. (4) The formation of the organic matter in the marine mud and its further decomposition are direct results of bacterial activities.

The bacteria are thus found to complete the cycle of life in the sea. Without the bacteria, life in the sea would soon come to a standstill. The recognition of the activities of these microscopic forms of life will help us to construct a better picture of the processes in the ocean and frequently exert a definite control over them.

NEWS FROM OTHER BIOLOGICAL STATIONS

MT. DESERT ISLAND BIOLOGICAL LABORATORY

The Weir Mitchell Station of the Mt. Desert Island Biological Laboratory in Salisbury Cove, opened on June 15th and by July 1st, twenty-one investigators were at work. Twenty-eight scientists are to do research during part or all of the summer. The list of investigators and their assistants follows:

Dr. James B. Allison, Rutgers University
Dr. H. B. Andervont, U. S. Public Health Service
Dr. Gerrit Bevelander, Union College
Dr. Esther F. Byrnes, Girls' High School, Brooklyn, N. Y.
Mr. Robert W. Clarke, Bellevue Medical College, New York University
Dr. William H. Cole, Rutgers University
Prof. Ulric Dahlgren, Princeton University
Dr. Allan L. Grafflin, Harvard Medical School
Dr. Robert W. Hegner, Johns Hopkins University
Dr. A. B. Howell, Johns Hopkins Medical School
Dr. Duncan S. Johnson, Johns Hopkins University
Dr. Percy L. Johnson, Missouri Valley College
Dr. Benjamin Kropp, Boston
Dr. Margaret R. Lewis, Carnegie Institution of Washington
Dr. Warren H. Lewis, Carnegie Institution of Washington
Dr. E. K. Marshall, Jr., Johns Hopkins Medical School
Dr. H. V. Neal, Tufts College
Dr. Earle B. Perkins, Rutgers University
Dr. Robert F. Pitts, Bellevue Medical College
Dr. George B. Roth, George Washington University
Dr. H. D. Senior, New York University
Dr. Werner Schopper, Giessen, Germany
Dr. James A. Shannon, New York University
Dr. H. W. Smith, New York University
Dr. M. M. Wintrobe, Johns Hopkins University

Assistants

Miss Edna Golden, Carnegie Institution of Washington, technician to Dr. and Mrs. Lewis
Mr. Cornelius T. Kaylor, Rutgers University, assistant to Dr. Perkins
Mr. George Meneely, Princeton University, assistant to Dr. Dahlgren
Miss Helen Smith, Rutgers University, assistant to Dr. Cole
Mr. Irwin W. Sizer, Rutgers University, assistant to Dr. Cole
Mr. Gordon Spence, Choate School, assistant to Dr. Grafflin.

—*Francis R. Snow, Secretary.*

On Tuesday afternoon, July 12th, Mr. and Mrs. H. V. Neal and Mr. and Mrs. Ulric Dahlgren welcomed Dr. and Mrs. Cole at Tea at Bow-End, the summer home of Mr. and Mrs. Neal. Dr. Cole is the new Director of the Weir Mitchell Station of the Mt. Desert Island Biological Laboratory, at Salisbury Cove.

Tea was served on the lawn, in the quaint old house built before 1800, and on the porch with its matchless view of Salisbury Cove. A perfect day brought out all the attractions of Bar Harbor and Salisbury Cove and made the occasion a very happy one indeed. A list of pourers follows:

Mrs. Walter Ayer, Miss Mary Dreier, Mrs. James D. Heard, Mrs. Clarence C. Little, Mrs. Philip Livingston, Mrs. Edward Porter May, Mrs. Warren K. Moorehead, Mrs. J. Tucker Murray, Mrs. Frank B. Rowell, Mrs. William Sauter, Mrs. John B. Thayer, III.

* * * *

The seminars for the season of 1932 have already begun. A list of those which have taken place follows:

Dr. Ulric Dahlgren, Princeton University, on June 27th, spoke on "A second type of contraction mechanism in Selachians."

Dr. James Allison, Rutgers University, on July 5th, spoke on "Chemical stimulation in animals."

Dr. Homer W. Smith, New York University, on July 11th discussed "Water regulation in fishes and its evolution." —*Frances R. Snow.*

THE IOWA LAKESIDE LABORATORY

The Iowa Lakeside Laboratory opened on June 20 for its twenty-fourth session with the following staff: Dr. G. W. Martin, of the University of Iowa, director and mycologist; Dr. H. S. Conrad, of Grinnell College, botanist, and Dr. P. L. Risley, of the University of Iowa, zoologist. As usual, field courses in botany and zoology are being offered and a number of students are conducting research in mycology, with particular attention to the slime-molds, the water molds, and the tremellaceous fungi. Dr. Catherine Mullin is continuing her work on leeches with special reference to regeneration.

Recent visitors include President Emeritus T. H. Macbride, of the University of Iowa, who is working on a revision of his book on myxomycetes, and Dr. Frank Thone, of Science Service.

The usual course of Wednesday evening lectures began on July 6 with a lecture by Professor Conard on "The Life of the bee."

FIELD BIOLOGY IN IOWA

The following letter has just been received from Dr. H. E. Jaques, President and Professor of Biology of Ohio Wesleyan College in Iowa:

I have your letter of July 2nd addressed to Lake Cooper Biological Laboratory, Montrose, Iowa. Instead of offering work at the Lake Cooper Laboratory this summer we have run a five weeks travel course through the state parks of Iowa. The work gave five semester credits in field biology. Attention was given to the flowering plants, trees, birds and insects of the regions visited. The central project of our department for several years has been a survey of Iowa insects with a view to showing their geographic and seasonal distribution. The entomological end of the trip thru the state parks was given first emphasis. Field work was done in forty-two of the ninety-nine Iowa counties and twenty of the Iowa state parks were visited. Over 10,000 specimens of insects were taken and mounted for the Iowa Survey collection. Many species not hitherto reported for the state were found. Seventeen hundred miles were covered in the trip.

Our address should be changed on the complimentary numbers of the Collecting Net which you are sending us, to Mt. Pleasant, Iowa.

I shall be glad to send items such as you ask for as often as possible."

SCRIPPS INSTITUTION OF OCEANOGRAPHY

(Received July 5)

Work of remodeling and improving the George H. Scripps ("old laboratory") building, some of which had been delayed on account of delayed allocation of funds, is now going forward again as the result of new arrangements for meeting costs. All of the equipment originally planned has now been delivered and most of it installed. After some additional work has been done in cleaning up the grounds and making certain readjustments incident to completing the work of construction and remodeling, it is expected that during the summer the Institution will hold a "housewarming" in celebration of the numerous improvements.

Dr. and Mrs. Leo Loeb of Washington University in St. Louis have returned to La Jolla for the summer, and Dr. Loeb will make use of Institution laboratory and library facilities.

Dr. and Mrs. W. S. Cole of the Department of Geology of the University of Ohio are spending the summer at the Institution in order that Dr. Cole may do some work on foraminifera with Director Vaughan.

Mr. Roy Morrison of the Horace Mann Junior High School of San Diego who has been making a study of the mollusks of San Diego Bay with special reference to their distribution in relation to environmental conditions, visited the Institution last week to get assistance in studies of saltiness of the water and of the character of the bottom deposits in that region.

Dr. D. L. Fox returned last week from his visit to the San Francisco Bay region, in the course of which he received the diploma for the Ph. D. degree awarded him last fall by Stanford University.

Miss Tillie Genter spent the last days of the month on her vacation in which she included a trip to the San Joaquin Valley.

(Received July 12)

On Friday of last week Mr. and Mrs. M. N. Bramlette of the United States Geological Survey visited the Institution. Mr. Bramlette was formerly associated with Director T. Wayland Vaughan in the work of the Geological Survey and he has given special attention to marine bottom samples, having written the important work on "Some Marine Bottom Samples from Pago Pago Harbor, Samoa." For a number of years he handled field work of investigation for oil companies in Mexico and South American countries. At the Institution he wished especially to consult Director Vaughan concerning conditions of deposition of certain kinds of rock strata and he spent some time with Prof. W. E. Allen in discussing the conditions influencing occurrence and abundance of marine diatoms of the present day.

Mr. Clem Copeland of the Department of Water and Power of the City of Los Angeles visited the Institution last week to consult Dr. C. F. McEwen about records of ocean temperatures and meteorological conditions used in rainfall prediction.

Dr. Florence Peebles of the Southern California Christian College arrived last week to use the Institution laboratories in certain zoological investigations of her own. Over the week end she was visited by Dr. and Mrs. H. S. Reed of the Citrus Experiment Station at Riverside.

On Monday of this week Dr. and Mrs. F. B. Sumner returned from a two months' vacation spent at their ranch in the San Jacinto Mountains.

On Tuesday of last week Dr. G. F. McEwen returned from his trip to the meetings of the Pacific Division of the American Association for the Advancement of Science held at Washington State College, Pullman, Washington.

On Monday of this week Dr. and Mrs. C. E. ZoBell returned from a two weeks' vacation trip by automobile to the Upper Snake River Valley in Idaho.

On Friday of last week Mr. Earl H. Myers was seized with an attack of acute appendicitis and was taken to the Scripps Memorial Hospital where he is recovering after a successful operation.

U. S. FISHERIES BIOLOGICAL LABORATORY AT BEAUFORT

The following list gives the biologists who are working this summer and the nature of their research problems:

Dr. H. V. Wilson, University of North Carolina; Development of Sponges.

Prof. Ezda Deviney, University of North Carolina; Regeneration in Ascidians.

Dr. Leon C. Chesley, Duke University; Digestion in marine fishes, and factors influencing action of Enzymes.

Dr. Elinor H. Behre, Louisiana State University; The effect of environmental variations on the chromatophores of some invertebrates.

Mr. Joseph M. Odiorne, Harvard University; Color changes in Fundulus.

Dr. Bert Cunningham, Duke University; Relation of temperature to the rate of embryological development in turtles.

Mr. Henry Vander Schalie, University of Michigan; The faunal relations of Naiades to brackish water.

Miss Mabel L. Bacon, University of North Carolina: The air-bladder and ear of certain teleost fishes.

GOVERNMENT INVESTIGATORS

Dr. Vera Koehring; Narcosis of the oyster muscle.

Dr. S. F. Hildebrand; Embryology of Bennies.

Dr. J. S. Gutsell; Life history and distribution of shrimp.

Miss Nell Henry; Artist.

Dr. H. F. Prytherch; Effect of Hydrogen Sulphide on the oyster.

THE DESERT LABORATORY

Dr. Forrest Shreve, in charge of the Desert Laboratory of the Carnegie Institution, Tucson, Arizona, and Dr. LeRoy Abrams, of Stanford University, California, have recently returned from a botanical expedition to central Sonora. The principal interest was in the ecological features of the vegetation and in the flora of the region.

CORPORATION ANNOUNCEMENT

The following notice was sent recently to members of the Corporation of the Marine Biological Laboratory:

At the meeting of the Corporation held August 11, 1931, it was voted that "On or about the first of July of each year, the Clerk shall send a circular letter to each member of the Corporation, giving the name of the Nominating Committee", (for considering the names of candidates for election as officers and Trustees), "and stating that the Committee desires suggestions regarding nominations".

Officers and Trustees are elected by the Corporation; members of the Corporation are elected only by the Trustees. The new officers — viz. Treasurer and the Clerk of the Corporation, are elected annually,—Trustees are elected for a term of four years. The present officers and Trustees of the Class of 1932, any one or all of whom may be re-elected, are as follows:

Treasurer of the Corporation
Lawrason Riggs, Jr.

Clerk of the Corporation..........Charles Packard

8 Trustees of the Class of 1932

R. Chambers	R. A. Harper
W. E. Garrey	A. P. Mathews
Caswell Grave	G. H. Parker
M. J. Greenman	C. R. Stockard

Any member who wishes to suggest names to be considered by the Nominating Committee should send them to the Chairman before August 1, 1932.

G. N. Calkins, Chairman
A. C. Redfield
L. V. Heilbrunn
H. H. Plough
Leigh Hoadley

Charles Packard, Clerk.

THE BEACH COMMITTEE MEETING

The Committee on Recreation Facilities held its first meeting in the Old Lecture Hall on Monday evening. This committee is made up of the following twenty individuals:

DR. R. P. BIGELOW
DR. R. A. BUDINGTON
DR. ROBERT CHAMBERS
DR. E. R. CLARK
DR. MANTON COPELAND
MR. ROBERT GOFFIN
DR. H. B. GOODRICH
DR. BENJAMIN GRAVE
DR. CASWELL GRAVE
DR. L. V. HEILBRUNN
MR. THOMAS LARKIN
MR. E. M. LEWIS
DR. EDWIN LINTON
MR. JAMES MCINNIS
DR. CHARLES R. PACKARD
DR. FERNANDUS PAYNE
DR. A. C. REDFIELD
DR. C. R. STOCKARD
DR. O. S. STRONG
CAPTAIN JOHN J. VEEDER

Only two members were absent. Dr. Redfield was making oceanographic observations from the *Atlantis* and Dr. Stockard had made an engagement for Monday evening before the date of the meeting had been set. Miss E. R. Mallard and Dr. James P. Warbasse were guests at the meeting.

The meeting was called to order by Dr. Goodrich, Chairman *pro tem,* who read the names of the members. Dr. Caswell Grave was appropriately elected chairman of the committee. He has been trustee of the Marine Biological Laboratory for a great many years, and thoroughly realizes the importance of maintaining a sufficient beach area for the scientific workers at Woods Hole. He owns property on Crow Hill and has long been a tax-payer in the Town of Falmouth. Dr. Grave is Rebstock Professor of Zoology and head of the department at Washington University.

Dr. Goodrich retained the chair for a few minutes so that Dr. Grave could review the beach situation on the Bay Shore. Before the meeting he had drawn a diagram of the beach and the lots immediately back of them, so that the group would have a clear picture of the conditions, which showed that the finer and larger section of the beach had been reserved for the private use of five investigators at the Marine Biological Laboratory. It was clearly brought out that the present beach in front of the bathhouses was inadequate to comfortably care for all the people who wanted to bathe there, and was likely to become still more crowded in later years unless the beach area could be expanded.

After Dr. Grave had completed his review and stated the problem which now faced the Woods Hole community, Dr. Goodrich requested him to assume the chair to which he had just been elected. Then followed an interesting discussion in which a great many people took part. Mr. Lewis, Park Commissioner for the Town of Falmouth, described the conditions in West Falmouth where the town had taken over a beach by the right of "eminent domain," and told how they had been successful in running it only for those persons living in Falmouth. This is done by admitting the would-be bathers and "sunners" only when they bring an identification ticket which must be obtained at the Police Headquarters in the Town Hall. He brought out another interesting fact; namely, that the town had appropriated the sum of $1,000.00 to improve the beach in front of the bathhouses in Woods Hole, but that it had to withdraw it again because they discovered that public funds could not be used to improve land under private control.

Mr. Larkin told of the growing tendency to restrict Nobska Beach, and said that he understood that its owners rather discouraged its use by groups of children. He emphasized the fact that Woods Hole must have a beach of its own, and saw no reason why the laboratory peeople should contribute money towards a beach when it was up to the town to provide one for everybody living in Woods Hole.

Captain Veeder, Harbor Master of the Town of Falmouth, expressed his doubt as to the right of the lot-holders to extend the fence below mean high water. Mr. Griffin voiced the same opinion. He also conveyed much information of importance to the committee, for he is a surveyor by training (Harvard '07) and has taken care of much of the surveying of the Fay estate during the last twenty years.

Mr. McInnis quietly listened to the discussion until the meeting was nearly over. Then he rose and with considerable feeling and in well chosen words said that the Town of Falmouth owed Woods Hole a beach, that two or three years ago it had spent $25,000.00 on one bathhouse alone in Falmouth Heights; *that the residents of Woods Hole paid more than one third of the total taxes each year in the Town of Falmouth,* that it was its duty to give a beach to Woods Hole, and further, that he believed that it would take over the Bay Shore beach by its right of "eminent domain" if the people of Woods Hole united to that end.

Although the local residents were most active in expressing their opinions, many of the laboratory people also took part in the discussion. Dr. Chambers, Dr. Goodrich, Dr. Bigelow, Dr. Budington, Dr. Copeland, Dr. Benjamin Grave, Dr. Heilbrunn and Dr. Strong expressed their opinions during the course of the meeting. In general the sentiment of the meeting seemed to be that town ownership of the Bay Shore was preferred rather than private ownership. However, no conclusions were reached. This meeting was initiated for the purpose of securing suggestions and talking over the situation in a general way. The group authorized the chairman to appoint a sub-committee of five to carefully investigate all the proposals that had been made at the meeting, with the instructions that it should report back to the larger group at a second meeting to be called soon. The following men were selected by the chairman to serve on this sub-committee:

Dr. E. R. Clark
Dr. H. B. Goodrich
Mr. G. A. Griffin
Mr. T. Larkin
Dr. C. R. Stockard

It has been learned that they will hold a meeting about the time this number of The Collecting Net is distributed in Woods Hole. It is understood that this sub-committee of five has invited the owners of the Bay Shore lots to present their side of the situation to them.

RECENT EVENTS IN THE ORIENT

Many searching questions were flung at Cameron Forbes, recent Ambassador to Japan from the United States, as he stood bareheaded on the Point of Penzance, and led the discussion at the Sunday afternoon Forum on July 10, where about sixty people were gathered.

"I cannot predict anything about the situation in the Orient, no one can, so I'll stick strictly to facts," he said in opening.

He briefly pictured for us the events of the past 30 years which finally culminated with the Japanese occupation of Manchuria and the difficulties in Shanghai; the disposal of Chinese soldiers; the plotted death of the ex-bandit Chinese General, Chang Iso Liu; the mysterious influence of his son and successor, Marshall Chang Iso Lung, and the setting up of a puppet Chinese government friendly to Japan, whose officials take no action not approved by the Japanese. So far, he told us, the Japanese people as a whole, had enthusiastically supported the military and political policies in Manchuria. They felt that the Chinese had been as weak as they had been vacillating in their protection of the billions of dollars worth of property invested by Japanese and other foreigners; and that the past list of Japanese grievances had not been recognized nor remedied by the impotent Chinese administration.

He described the series of provocations which led up to the bombardment of Shanghai; and the happiness in Japan when the armistice was declared and this unpopular situation, of which the Japanese heartily disapproved, was terminated.

Perhaps the most illuminating reply to any question addressed to Mr. Forbes was concerning the expansion of Japanese population: "If, as you say, Formosa, as well as the fertile northern island, are sparsley populated, and there are not many Japanese in Bengal where the Government definitely invites and seeks for Japanese colonization, why does Japan claim she needs Manchuria and why does Japan resent the Japanese "Exclusion Act" of the United States?" He replied, "Japan needs Manchuria, not for colonization, but for trade, for a market for her goods; and for some raw materials. Japan resents the humiliation of the "Exclusion Act," because it is only directed against her. If Japanese were admitted on the same quota basis as other foreigners to the United States, Japanese feelings would not be hurt;" and he added significantly, "more are smuggled in illegally now than there would be otherwise, for Japan would cooperate to keep within the quota; while now she does nothing about it but nurses her resentment."

Despite all Mr. Forbe's first hand information and his illuminating interpretation of events, the Orient still remains, to us Occidentals, as it always has been;—an enigma. —*A. D. W.*

The Board of Trustees of Wellesley College has made Dr. Margaret C. Ferguson research professor of botany. She retires from active service in the department of which she was appointed chairman in 1904. Dr. Ferguson will continue her cytological and genetical studies of *Petunia* at the college. Dr. Laetitia M. Snow has been appointed professor of botany and has been granted leave of absence for the coming year. She will continue her work on bacteria in wind-blown sand at the Hopkins Marine Station, Pacific Grove, California.

A daughter, Marjorie Jean Hill, was born on March 14, in New York, to Dr. and Mrs. Samuel E. Hill. She is a granddaughter of Captain and Mrs. Robert Veeder.

Dr. and Mrs. George Julius Heuer of Cincinnati have taken the Warbasse's "Pond House" for the summer. Dr. Heuer is a surgeon of note.

SUPPLEMENTARY DIRECTORY

MARINE BIOLOGICAL LABORATORY

Investigators

Apgar, R. proto. Pennsylvania. Br 211. Hubbard, East.
Bozler, E. fel. med. physics. Pennsylvania. Br 231. Glaser, Gosnold.
Bridges, B. res. asst. Carnegie Inst. Wash. Br 324. McLeish, Millfield.
Brown, Dorothy J. edit. asst. Princeton. Br 303. A 207.
Carlson, J. G. instr. biol. Bryn Mawr. L 25. Nickerson, Millfield.
Clark, J. M. Wilson. Br 219. W a.
Einarson, L. res. fel. anat. Hopkins Med. Br 107. D 212.
Kempton, R. T. instr. biol. New York. Br 339. Lehy, Millfield.
Marinelli, L. D. O. asst. physicist. Memorial Hosp. (New York) Br 307. Dr 5.
Martin, E. A. asst. prof. zool. Brooklyn. Bot 5. Park.
Morill, C. V. assoc. prof. anat. Cornell Med. L 24. Cape Codder (Sippiwisset).
Nelsen, O. E. instr. zool. Pennsylvania. OM 27. D 306.
Palmer, A. H. grad. res. Belleview Med. Br 310. Water.
Payne, F. prof. zool. and dean Grad. Sch. Indiana. Br 118. A 201.
Reznikoff, P. instr. med. Cornell Med. Br 222. McKenzie, Pleasant.
Schauffler, W. G. invest. Princeton. OM 40. Fish.
Shumway, W. prof. zool. Illinois. L 23. Broderick, North.
Vicari, Emilia M. assoc. anat. Cornell Med. Br 317. A 305.
Warren, H. C. Stuart prof. psych. Princeton. Br 303. "To Windward", Bar Neck.
Woodruff, L. L. prof. proto. Yale, Br 323. Agassiz Place.

DOMESTIC HELP

Brown, Bertha C. Ho 111.
Colby, Anne H. Ho 203.
Colomy, G. Ho 112.
Coombs, J. Ho 113.
Coombs, Nellie E. general manager. Ho 12.
Curtis, W. D. Dr.
Downing, Florence E. Ho 205
Downing, Isabella in charge dining room. Ho 201.
Duest, Virginia C. Ho 211.
Gray, R. J. Ho 106.
Jackson, J. P. K.
Moon Louise N. Gorham Normal Sch. Ho 202.
Nordstrom, K. A. W. chef. Ho 6.
Pereira, J. R. Suffolk Law. 2nd chef. Ho 107.
Porteus, W. Ho 108.
Skea, Katy Ho 207.
Stark, Nancy American (Washington) Ho 204.
Steele, N. A. Ho 108.
Temple, E. F. Ho 7.
Weymouth, Dura N. Ho 10.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Investigators

Bixby, E. May res. asst. chem. Harvard Med. 109. Young, West.
Campbell, Mildred H. grad. biol. Toronto. 108. Thompson, Water.
Carey, Cornelia L. asst. prof. bot. Barnard. 202. Quissett.
Emmons, G. instr. meteorology. Harvard. 209. (Monument Beach)
Fries, E. F. B. office edit. for biol. scie. G. & C. Merriam Co. 101. Neal, West.
Gran, H. H. prof. bot. Oslo (Norway) 106. D.
Green, Arda A. res. fel. Harvard. 101. D. 218.
Hotchkiss, Margaret instr. bact. Homeopathic Med. Wilde, Gardiner.
Iselin, C. 2nd Capt. "Atlantis". 206. (Racing Beach).
Lichtblau, S. res. asst. Mass. Inst. Tech. 209.
Macdonald, R. sst. prof. zool. Harvard. 111. Fairlawn, Glendon.
McMurray, F. S. Master "The Atlantis." 214. "The Atlantis."
Rossby, C. G. prof. meteor. Mass. Inst. Tech. 208. Oak, Park.
Sears, Mary grad. Radcliffe, 108. Hilton, Water.
Wilson, C. B. retir. head sc. dept. Mass. State Teach. Col. 211. Clough, Millfield.

M. B. L. CLUB

The officers and the executive committee of the M. B. L. Club would appreciate suggestions and criticisms. Such suggestions may be placed in the suggestion box near the bulletin board in the club-house. The officers realize that the Club can play a much larger part in the recreational activities of laboratory workers and their families.

Various improvements have been proposed. One or two of these have already been acted on. Current magazines have been placed on file and a subscription has been entered for the *New York Times*. A small lending library of recently published books will also be started in the near future. The Club would be very grateful to any members who might care to contribute books or magazines.

We are considering the possibility of installing a radio. One or two members have offered to loan their radio sets for a week at a time. If several other radio owners could be induced to loan their sets for a week apiece, the problem of securing a radio for this summer might be solved. For the present, such a scheme might be wiser than the purchase of a radio for we could discover whether or not the installation of a radio would be advantageous. Obviously, there would have to be some restrictions as to its use.

It has been suggested that the Club rent out canoes or rowboats to its members. Some of the laboratory workers come for only a few weeks and it is hardly possible for them to rent rowboats or canoes. If the Club could rent boats for the summer, it might sublet them to members by the day or hour. It is thought that there are boats now idle which could be turned over to the Club for rental to its members.

Finally, if the Club is to function properly, it must have the support of its members. Suggestions and criticisms are a real help. We also need money. Dues may be paid at the office of the Laboratory. Privileges of the Club are open only to members in good standing.

—*Executive Committee.*

The Collecting Net

A weekly publication devoted to the scientific work at Woods Hole.

WOODS HOLE, MASS.

Ware Cattell .... Editor

Assistant Editors

Florence L. Spooner Annaleida S. Cattell

Vera Warbasse

Contributing Editor to Woods Hole Log

T. C. Wyman

The Beach Question

Until the meeting of the Committee on Recreational Facilities met on Monday evening few people realized how strong the sentiment was against the recent encroachments upon the assumed rights of the individual to the use of the land at the waters' edge. Many of us realized that, in general, the laboratory group objected to the amputation for private use of the larger and better portion of the Bay Shore bathing beach; but they did not appreciate how bitter some of the local residents have become about the matter. It is natural that now the townspeople should strongly feel that the Town of Falmouth ought to assume control of a good beach in Woods Hole. The progress of Woods Hole, and therefore the welfare of its inhabitants, is intimately bound up with the beach area available. If the privileges of bathing on a good beach are limited it will make Woods Hole a less desirable place in which to live. This condition will be reflected by a decrease in the value of land and buildings, and by a definite decline in the business of its merchants.

We have always firmly believed that if the lot-holders on the Bay Shore fully realized how many scientific workers in Woods Hole object to the fence, they would immediately take steps to modify or even remove the restrictions which they have placed upon the beach. To our mind, it is imperative that this restricted area again be made available to the people living in Woods Hole. In spite of the overwhelming sentiment of the meeting in favor of town ownership we are not altogether convinced that it is the wisest solution of the problem. If the beach can be opened to the community with only minor restrictions, and if a way can be devised to insure the *permanency* of this arrangement, we believe that this latter plan should receive very serious consideration.

The department entitled "Items of Interest" is probably of more interest to our readers than anything else that we print. Any assistance that may be given to us in extending its usefulness will be much appreciated.

BOOK REVIEW

Chemical Plant Physiology. S. KOSTYCHEV. Trans. and ed. by C. J. LYON (Dartmouth) xv + 497 pp. Illus. Blakiston. 1931.

Biologists are again indebted to Dr. Lyon for making available in English another book from the Russian school. This is a translation of the 1926 edition of the first volume of the "Lehrbuch der Pflanzen-physiologie" but is brought up to date by many brief references to recent investigations added by the translator in footnotes. After a short biochemical introduction on foundations the assimilation of solar energy by green plants and the primary synthesis of organic compounds are discussed in detail. Chapters on chemosynthesis and the assimilation of molecular nitrogen, plant nutrition with prepared organic compounds, mineral nutrients, carbohydrates and proteins, and secondary plant substances follow. The last chapter presents respiration and fermentation. Emphasis is placed more on the analysis of the processes occuring in plant life than on the mere description of the substances involved. Access to the original literature is accomplished by extensive bibliographic references on nearly every page. The reader interested in the chemical aspect of the life of plants may follow the trends and skip the detail of chemical formulae, and, in many cases, data on the analytical procedures, which another reader wishing specific information will find most welcome. The general physiologist will find it a valuable reference work and the botanist will find more information in this volume than in some larger volumes. It is to be hoped that the second volume will soon appear and that Dr. Lyon will render it as lucidly into English as he has the first. —*Oscar W. Richards.*

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
July 17	4:15	4:24
July 18	5:08	5:17
July 19	5:57	6:08
July 20	6:44	6:58
July 21	7:32	7:48
July 22	8:17	8:36
July 23	9:03	9:29
July 24	9:50	10:21

In each case the current changes approximately six hours later and runs from the Sound to the Bay. It must be remembered that the schedule printed above is dependent upon the wind.

ITEMS OF INTEREST

Dr. D. S. Edwards, professor of physiology left Woods Hole for New York last Sunday to assist in installing the physiology department in the new buildings of Cornell University Medical School next to the Rockefeller Institute.

Dr. Jacques J. Bronfenbrenner, professor of bacteriology at Washington University, is working this summer at Woods Hole, although he has not reserved a laboratory room.

Dr. Phillip Bard left Woods Hole last Thursday for Boston where he will continue his research work at Harvard Medical School. He plans to return on July 21, but will be absent from here off and on through the summer.

Dr. Robert M. Stabler, instructor in protozoology at the Laboratory has rented Dr. Whiting's cottage in the Gansett woods for the summer. Dr. and Mrs. Whiting are occupying their apartment in Philadelphia this summer.

Dr. Frank R. Lillie was awarded an honorary degree of Doctor of Science by Yale University at its commencement in June. In presenting Dr. Lillie as a candidate Professor Phelps said:

"Born in Toronto, student of that university, he took his doctor's degree at the University of Chicago. Like several other million scholars, he was a member of the faculty of the University of Michigan, the foremost professorial training school in America. He is professor of embryology at the University of Chicago, dean of the School of Biological Science and Medicine, director of the Marine Biological Laboratory at Woods Hole. He is a member of many learned societies in Europe and in America. He has to an extraordinary degree combined executive management with individual research. His investigations in embryology, cytology and physiology have won for him an international reputation. The growth of the famous laboratory at Woods Hole is a monument to his scientific and administrative ability. He has taken a leading part in the organization of biological research, having trained a large number of young men, who are inspired both by his teaching and by his example

In conferring the degree President Angell said:

"A distinguished biologist, a sound and fruitful investigator, a stimulating teacher and trainer of men, your long career has been marked by constant advance to larger and more important achievement. In recognition of your eminent service, Yale confers upon you the degree of Doctor of Science, and admits you to all its rights and privileges.

Dr. William R. Amberson sailed on July 3 on the *Brittanic* from Boston. He planned to meet his family in Germany and will work this summer with Paul Hober. Dr. Amberson will return in the Fall to resume his work as professor of physiology at the University of Tennessee.

The two small seals which are attracting so much attention in the outdoor pool by the Fish Commission, are known as Harbor or Dog-haired seals, and differ in many ways from the seals which supply us with our fur coats. They never grow much larger than they are now, and these two seals are about two-thirds grown at the present time. Their hair is short, and of a plushy texture, and when they are completely dried off their fur resembles moss. They seem extremely lazy at times, but when they dart about underneath the water, one realizes how very swift and graceful they can be. They enjoy feeding on small round fish, but their favorite dish is herring—with which Mr. Goffin supplies them. It is said they prefer a much colder climate than we have in the summertime, but Mr. Goffin fully expects to keep them here until Fall. —*F. L. S.*

FROM THE BULLETIN BOARD

Wanted in 1932-33. Teaching position or position as research assistant in Zoology or Physiology. A. B. Goucher College. 1930. A. M. Syracuse University 1932. Graduate assistant Syracuse University 1930-32. Please inquire in office for further information.

Mr. George T. Steis, department of bacteriology and New York University, is applying for a research position this summer. Mr. Steis is recommended by Dr. Klasterman.

Assistant Technician. 2nd year Medical student and Radcliffe graduate with previous experience as assistant at M. B. L., wants work in August. For particulars apply to Professor G. H. Parker, M. B. L.

Manuscripts and general typing. Brick 339. Alice Marsland.

The Uhlenhuth Cottage on Brooks Road to rent; from July 1 to August 1. Three bedrooms, kitchen, large living room and screened porch. For particulars see Mr. MacNaught.

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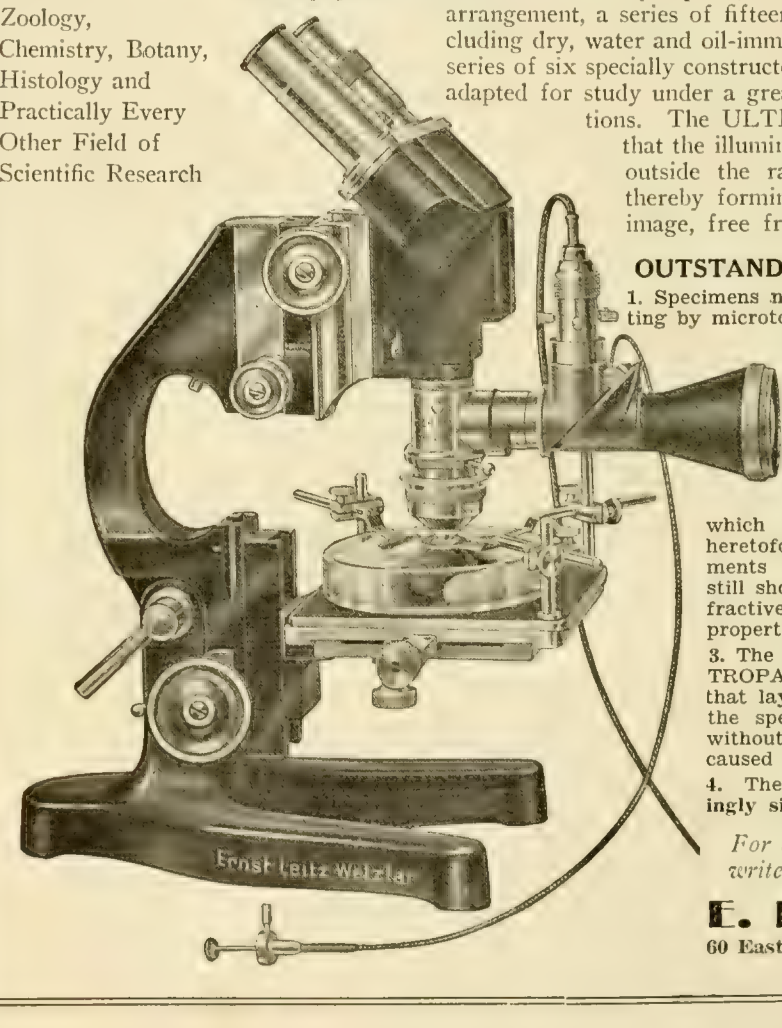

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THE WOODS HOLE LOG

LABORATORY STUDENTS RESCUED

Just as the last cake of a cargo of ice had been stowed away on board the *Eben A. Thacher* as she lay at the steamboat dock last Thursday morning shortly after ten o'clock seaman Paiva saw a small sailing dory capsize about midway between there and Naushon Island. He quickly called the attention of Captain Stevenson and Joe Pinto to the mishap, and in a moment the engine was started and the mooring lines were cast off. As the boat began to move, Robert Leighton and Gifford Griffin jumped aboard, and without a moment's delay the rescue craft sped on toward the overturned dory to which a young man and a young woman were clinging. Evidently the Coast Guard base had been notified, for a fast picket boat appeared speeding toward the scene of the accident along with a boat belonging to the Marine Biological Laboratory. The *Eben A. Thacher* was the first to arrive, however, and after a bit of skillful manouvering, a line was thrown to the man and to the woman who were still clinging to their overturned craft, and they were hauled aboard. The mast and sail were then taken from the water and the crew of the *Eben A. Thacher* succeeded in getting enough water out of the overturned dory so that it could be towed back to the dock in Woods Hole. After ascertaining that they could be of no assistance, the Coast Guard boat and the Laboratory boat returned to port. Quite a few people who were waiting for the boat to the islands gathered on the steamboat dock to watch the rescue. —*T. C. W.*

Last Sunday afternoon in the rough seas, a sailboat manned by two students at the laboratory, Frank Craig and James Heyl, and a young lady, Anjie Green, were rescued after having clung to their capsized craft for half an hour. They were sailing in the *Putty and Paint*, off Nobska Point, when they turned over. Rather than risking a long swim to shore, they clung to their boat. John Sdharff, the light house keeper, observed their plight and summoned the Coast Guard. Before the government boat arrived, the *Billy M 3rd*, a cabin cruiser, picked them up, unharmed by their experience. —*V. W.*

Two young men had a narrow escape about two weeks ago when a small boat in which they were sailing capsized off Naushon Island. They were rescued by a power boat which was anchored off the island at the time, and were brought back to Woods Hole. Later in the afternoon a Coast Guard patrol boat, the C-G 910, towed the sail boat, still capsized, back to the harbor here.

GOVERNOR ROOSEVELT'S VISIT TO CAPE

The previously announced plans of Governor Franklin D. Roosevelt and his three sons to visit Woods Hole on the *Myth II* did not materialize. It is not clear whether this was due to the unfavorable sailing conditions—little wind and a head tide—or to the fact that Mr. Charles R. Crane, who was to be his host, was absent from his home on Juniper Point.

Captain Veeder had orders to keep up steam in the *Cayadetta* until late in the evening on Wednesday, and more than once he was observed scouting in the Sound and in the Bay for Roosevelt's yawl. We understand that he was in Cuttyhunk Harbor when the Roosevelts entered and anchored there.

The Western Union Office in Woods Hole had six operators on duty in anticipation of the special occasion, because sometimes newspaper reporters were supposed to be following his every move in a special press boat *Marcon*.

On Thursday morning the scheduled botany trip on the *Cayadetta* was postponed for about two hours, because it was thought that he might still visit Woods Hole before passing through the Canal.

After spending the night off Buzzards Bay the Roosevelts' yawl emerged from the Cape Cod Canal out onto Massachusetts Bay, being towed by the *Ambassadress,* a power yacht. It is rumored that Governor Roosevelt will visit Woods Hole in the *Myth* before he returns to New York.

Winners in the Woods Hole Yacht Club Race held on Monday, July 11.

Buzzard's Bay Class: Louise Crane in the *Scampi;*
Cape Cod Knockabouts: Comstock Glaser in the *Porpoise;*
Club Dories: Wistar Meigs in the *Aunt Addie;*
Catboats: Alfred Compton in the *Turline.*

The first race for larger boats which has been held in the Vineyard Sound was last Wednesday afternoon. Ed Norman sailing the "Gull" won the "S" boat race. There were not enough boats in the handicap class so the two entries raced informally.

Last summer Dr. Kenneth Cole, assistant professor of physiology at Columbia University had an open sailing dory which he used in the Woods Hole Yacht Club races. This summer he has graduated to a nifty black catboat. —*V. W.*

Mrs Murray Crane and her family have arrived at Woods Hole. Mr. and Mrs. Bruce Crane who were married this May will return from Europe some time in August and will visit in Woods Hole during the rest of the summer.

THE WOODS HOLE LOG

A RAMBLE THROUGH THE WOODS HOLE SHOPPING DISTRICT

I was a stranger in Woods Hole, and out of idle curiosity looked around at the various shops. In James restaurant across the street from the station I bought a copy of The Collecting Net and decided to visit the various stores listed in that magazine. I found that they were not equal to Fifth Avenue in grandeur, but that they were far superior from the point of view of a real personal interest in their customers. I discovered that Sam Cahoon was the only person from whom you could get your fish, and that it is brought to him at his door directly from the local fishermen. Practically all the fishermen in this district sell their wares to him and he in turn ships them on to Boston and New York. Not only does he buy from the fishermen, but he also sells about every article a fisherman would possibly need, from sou' westers, rope and tackle, to screws and nails. It is of great interest to those waiting around on the wharf to watch the boats hoist up their barrels of freshly-caught fish to Sam Cahoon's dock where they are weighed and packed in ice.

I wanted to buy some small souvenirs, and noticed that down the street from the fish market was an attractive gift shop belonging to Mrs. Bradford. She had every variety of gift, and an unusually large assortment. Among other things, she sells hosiery, underwear and some dresses.

By the draw-bridge is the town's one barber shop run by Mr. Sansouci. They do every kind of work along that line, from shaving to giving permanent waves.

Dolinsky, the Tailor, gets suits pressed in a very short time. He also does general repairing of clothes, and has men's clothes for sale.

The Twin Door is a delightful place to have one's dinner. Their specialty is home-made pastry. I have noticed that this place is very popular with the laboratory members.

The Ideal Restaurant seems to be one of the most popular places to dine. Their food, as I know it, is as delicious as that served at home. They serve excellent three-course dinners for 55c.

The Oasis is the only store in Woods Hole which sells medical supplies, and is also a popular eating resort at night, for it stays open until eleven o'clock.

Tsiknas has delicious fresh fruits and green vegetables and because they deliver their goods they offer competition with their neighbor, the A. & P.

The Penzance Garage not only sells gasoline to autos passing by on Main Street, but also to motor boats in the harbor, and for this purpose it has a dock with a filling station.

The Quality Shop, just across the street, is the only store which offers bathing caps, clothes hangers, stationery supplies, socks and sneakers.

I spent the night at the Breakwater Hotel. A delightful homy place with an excellent view of the harbor. This hotel has the restful atmosphere which is exceedingly pleasant after a long day. A summer in Woods Hole must be doubly delightful if one stays at the Breakwater Hotel.

Returning to the dock before I took the Airplane, I found another excellent garage, the Woods Hole Garage. It was formerly two garages which have been combined into one. Its convenient location, directly across from the station, and its superior work bring it plenty of business.

Mr. Luscombe has charge of the real estate and insurance in Woods Hole, and because he has been here for so many years, he probably does it very efficiently.

All in all, the stores and shops in Woods Hole are not merely convenient, but offer a variety and scope which are unusual in such a very little town. —*Vera Warbasse.*

DANCING

The year before last, many Woods Hole residents took an opportunity to learn dancing. Gloria Braggiotti is returning again this July, and will hold classes including tap dancing, musical comedy and classical dancing.

Ted Shawn, during the first week of August, will give dancing lessons also. He, together with Ruth St. Dennis, has been in great demand all over the country for his excellent interpretive dancing.

Pupils from this course and Gloria Braggiotti's will be given first chance on the list of applicants for the ballet in "Lysistrata", which is to be directed by Ted Shawn, and produced by the Theatre Unit during August.

The *Constance,* a black schooner which belongs to Mr. Prosser of Penzance Point, will be in the harbor again this summer, after an absence of a year.

This summer the Ratcliffes are living with the Nims. Tom Ratcliffe is again running the Book Club. This Club lends out books which have been published during the previous year.

Last Wednesday afternoon the grandchildren of Mr. Walter O. Luscombe gave some charming dances on the lawn for their grandfather's friends.

THE WOODS HOLE LOG

After the gang planks of the *Naushon* had been withdrawn one day last week, Dick Stockard was hailed by one of the crew and told to run to the freight office and get the latter's lunch-box. Dick dashed to and from the freight house, but upon his return the boat was already in motion. He darted to the end of the pier and hurled the lunch-box at the doorway. But, alas, the boat was moving fast and the wind was blowing hard—the lunch-box banged against the side of the vessel and dropped into the churning waters below.

Just as the 1:05 P. M. boat for Nantucket was leaving the dock last Friday, Dr. Alfred Meyers, a summer resident here for many years, fell off the seaplane float. He stepped back to get clear of the struts on the seaplane and did not realize that he was so near the edge of the float. Gifford Griffin seeing him in the water, held him up until Curley, the local agent for the seaplane company, reached him, and then they both pulled the doctor out of the water. Mr. Vallis, who saw the incident, sent for one of Savery's taxies to take the doctor home. —*T. C. W.*

The subject for the next Sunday discussion on Penzance Point is "Modern Methods in Progressive Education". The speaker is Mr. Malcolm Forbes, a psychologist from Rollins College, Florida.

There will be a Lobster Supper at the Methodist Church on the evening of July 22, at six and seven o'clock. Tickets will be 30c for children and 60c for adults. Everyone is cordially invited to attend.

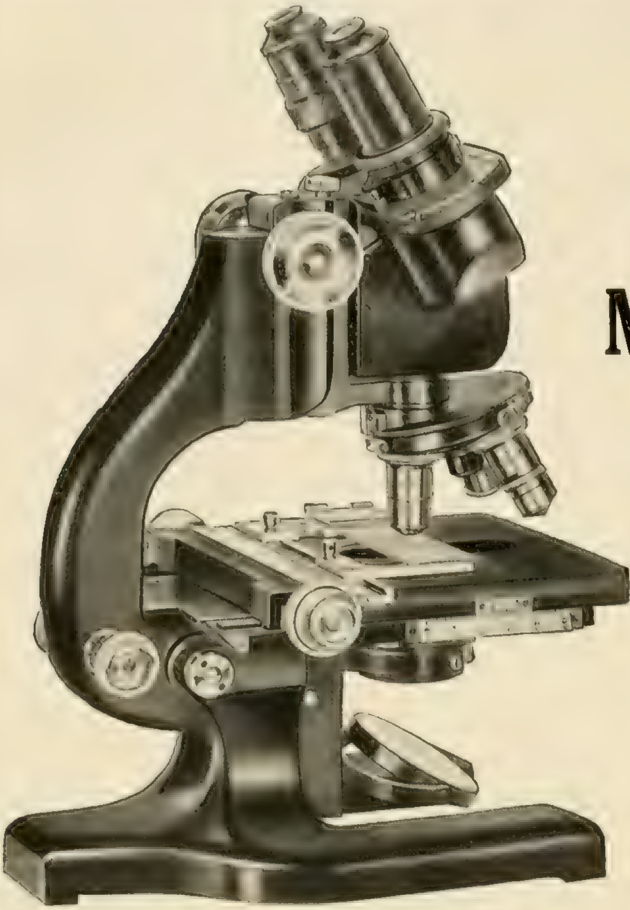
WOODS HOLE PATERS PUNISH

The shrieks and cries of the boys of Woods Hole could be heard for miles Wednesday night. But fortunately they were expressions of elation rather than anguish. For the boys were having a marvelous time watching their dads punish the paters of the Falmouth boys in another thrilling baseball game by the score of 19-10.

A great throng crowding around the diamond at Woods Hole Park, Wednesday, July 13th, split their sides and yelled themselves hoarse, as they watched "the old-timers" (pardon us) cavort about. The rivalry was particularly intense in this encounter, as Falmouth came over to avenge the crushing defeat given them two weeks ago by the Woods Hole fathers. But the stellar twirling of Roy Berg, the daring sliding of Ned Gifford, and the healthy wallops off the bats of McInnes, Clough, Goffin, Savery and others were just too much for the Falmouth "boys". The game went the full nine innings, and Jim Mulligan went the entire route in center field for Falmouth. Even though Falmouth used three crack pitchers, Allenby, English and Wallace, they were unable to subdue the Woods Hole tribe.

Those participating in the paternal sporting events were: (Woods Hole) Gifford, McInnes, Larkin, Berg, Eldredge (Stanley), Clough, Savery, Goffin, Cahoon (Nelson), Thomas, Clements, Leahy, and Griffin, G. A. (Falmouth) Hastay, Panton, Lawrence (Sumner), Wallace, English, Hubbard, Davis, Mulligan, Rose, and Allenby.

—*A Baseball Fan.*



THE COLLECTING NET

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THE TENSION AT THE SURFACE OF AMOEBA DUBIA

Dr. E. N. Harvey and D. Marsland
Princeton and New York University.

"Surface tension" has played an important part in the development of theories of amoeboid movement. However, definite measurements of the magnitude of the surface forces, whether surface tension or elastic tension of amoeboid cells, have been lacking. The present work is an attempt to supply this information.

The classical methods of measuring surface tension at liquid interfaces, for obvious reasons, can not be used to determine surface forces of living cells. Recently, however, two widely different methods have appeared which seem to be giving results in good agreement each with the other. The egg compressor of K. C. Cole applies forces, controllable to a fraction of a microgram to the surface of the cell. The cell is compressed and the distorting force may be related to the surface forces resisting distortion. This method, however, (*Continued on Page* 115)

M. B. L. Calendar

MONDAY JULY 25, 8:00 P. M.
Lecture. Dr. Leif Stoermer, "Were the Trilobites Related to Limulus?"

TUESDAY, JULY 26, 8:00 P. M.
Seminar. Dr. M. M. Brooks, "Antagonism of Methylene Blue for CN and CO."
Dr. S. C. Brooks "Partition Coefficients and Diffusion of Solutes in Heterogeneous Systems."
Dr. A. P. Mathews "Nature of the Action of Enzymes."
Dr. Laurence Irving and Mr. A. L. Chute, "The Participation of Bone in the Neutralization of Ingested Acid."

FRIDAY, JULY 29, 8:00 P. M.
Lecture. Dr. C. C. Speidel, "The Growth and Repair of Living Nerves."

THE SPEED OF LIFE

Review of the Lecture by Dr. R. W. Gerard
Associate Professor of Physiology, University of Chicago.

Living things are frequently distinguished by three different properties: (1) behavior, particularly as indicated by movement and response; (2) growth and reproduction; and (3) metabolic activity. Under certain conditions in many organisms each of these properties can be greatly reduced, even to complete disappearance. This is particularly true of the first two, but frequently even chemical activity appears to be nearly suspended as in some hybernating plants and animals or completely interrupted as in typhoid bacilli which can be cooled to a degree above absolute zero and later revived. If then, vital activity can be suspended at times and restored on the return of favorable conditions, the criterion of life which remains is the rate of metabolic activity, and one of the basic problems regarding life is the study of the factors controlling this rate.

Whatever a living thing does, whether behav-

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ing, growing, reproducing, or functioning chemically, it requires energy. Since the bulk of energy available in organisms is liberated by oxidative processes, these processes are most significant in the study of chemical activity in living things. Oxidation consists in an increase in the positive valence of a compound and is usually accomplished either by the gain of oxygen or by the loss of hydrogen. Certain environmental conditions are necessary for oxidation to occur. For example, under ordinary conditions sugar and oxygen do not react, but in a strongly alkaline mixture, sugar is readily oxidized or burned, and in living cells it is oxidized continuously and easily. This oxidation within a cell is permitted by the presence of certain agents which act as catalysts in controlling the rate and direction of reactions.

The rate of oxidation and hence the speed of life can be varied by altering any one of the factors in the oxidative reaction. This reaction is: substrate+oxygen+catalyst→end products. Environmental conditions such as temperature, moisture and hydrogen-ion concentration, of course, play a part, but if these are controlled the oxidative rate can be studied by varying one or more of the factors in the reaction. As a whole, these constitute the internal factors of respiration. The effect of variation in each of these factors within the cell may be considered briefly.

The substrate consists of the material used by the cell as fuel for the oxidation and its utilization is conditioned mainly by its ability to enter a cell and by its available concentration. For example, when food is supplied to a tissue as in the addition of sugar to yeast or sarcina, the respiration of the cells increases markedly up to a certain limit beyond which further increase in available substrate has no additional effect on respiration. The effect of oxygen, also, is conditioned by the permeability of the cell to it and by its available concentration. The relation is not necessarily linear and it has been shown, for example, that in fertilized Arbacia eggs, as the oxygen tension rises, the respiration increases to a constant rate at a partial pressure of oxygen well below that in air and that further increase in oxygen does not increase the respiration of the cells. End products limit the rate of oxidation by their accumulation. For example, when carbon dioxide or lactic acid are permitted to accumulate in a tissue, the rate of oxidation decreases as these substances increase. If, however, the end products are removed before accumulation, no effect is observed. None of these three factors ultimately limit the rate of oxidation because beyond certain concentrations they are not critical. Hence the critical factor must be the respiratory catalyst.

Oxidative catalysts are better known by what they do than by what they are, and evidence concerning their action is derived primarily from the study of factors which impede or accelerate their action. Their activity can be depressed, though rarely to zero, by various inhibiting agents such as cyanide, carbon monoxide, and certain narcotics. After such harsh treatment as the application of acid, cytolysis, coagulation, freezing, or maceration, catalytic activity is decreased to approximately one-fourth to one-third its original value, but usually a significant and fairly constant amount of respiration persists. It is likely that this residual oxygen consumption is really a partial oxidation of unsaturated lipoids, which is catalysed by fairly stable haemin bodies. Tissues can be frozen and dried cold to a powder, and when moistened, they subsequently exhibit an oxygen consumption of as much as half the original value. The consumption is more in adrenal containing much unsaturated lipoid than in many other tissues, such as liver.

The dye, methylene blue, can increase the activity of these catalysts or even in part supplant them. When, for example, methylene blue is added to respiring tissues, such as red blood cells, nerve, sarcina, or muscle, the rate of respiration increases, or when methylene blue is added to tissues in which the respiration has been depressed by cyanide, the respiration may be restored.

The effect of a loss of the oxidative catalysts when part of a cell is separated from the metabolic center is illustrated by the effect of a nerve cell-body on the nerve fiber. It is well known that when a nerve is cut, the part separated from the cell body degenerates, also that a muscle supplied by such a nerve changes after the nerve is cut. If a nerve, which is separated from its cell body, is stimulated regularly after transection, it degenerates more rapidly than an unstimulated nerve. Hence the normal effect in maintaining the nerve in a healthy condition should be due to the movement of some chemical along the nerve from the cell body rather than to continued activating impulses. It appears likely that the respiratory enzyme, normally reaching the fiber from the cell body, is used up faster during the more rapid oxidation in the active nerve.

The above factors constitute the more important internal factors controlling respiration. When a tissue becomes active, changes in external conditions are involved, and new complications are introduced into the oxidative mechanism. For example, when bacteria are added to a culture of leucocytes, the respiration of the latter cells increases during phagocytosis, associated presumably with the increased activity. The specificity of some external factors is illustrated by two further examples. When thyroxin is added to any of a variety of tissues investigated, except the thyroid gland itself, the respiration is increased, but when added to thyroid tissue, the respiration is diminished. Similarly, secretin, which as normally liberated in the duodenum stimulates pancreatic secretion, markedly increases the rate of respiration of the pancreas but has no effect on other tissues.

Still further external complications are introduced in the respiratory mechanism when the tissues are not isolated but are subjected to all the influences of the host organism. The organism, as a whole, maintains a state of equilibrium mainly by two methods, by hormonal and by nervous control, and nervous influences may be further divided into electro-physical and chemical. A delicate balance is maintained both in isolated tissues and in entire organisms between ions such as calcium and potassium, hydrogen and hydroxyl, between respiratory catalysts and inhibitors, and between control by different parts of the nervous system such as the sympathetic and parasympathetic. The reason for this delicate balance may well be the accurate control of the respiratory rate in the single cell.

What is the source of the catalysts which, by their control of rates of reaction, lead to cell composition and structure? In some manner there is formed at some time an autocatalytic molecule which produces more like molecules and also produces new catalysts, which in turn control the formation of cell constituents, and thus the cell and finally the entire organism develop. From this viewpoint the gene may be considered the molecule of the basic autocatalyst, itself slowly altered as the basis of evolution.

The present picture of oxidative mechanisms and the resulting liberation of energy is, at best, confused and indefinite. "It may be, however, that we are nearer than we believe to a deeper insight into the significance of much that we know and that a well directed question or two may lead Nature to give crucial evidence on the mechanisms controlling the speed of life and so life itself."

—*C. Ladd Prosser.*

THE TENSION AT THE SURFACE OF AMOEBA DUBIA

(Continued from Page 113)

is best adapted for measurements upon spherical cells such as the Arbacia egg. To measure the tension at the surface of Amoeba where the form is so irregular and changeable the Harvey-Loomis centrifuge-microscope was used. A cell while being subjected to high centrifugal forces is kept under continuous observation. If such a cell contains oil (or other material whose density is less than the water around the cell) the buoyancy of the oil will exert a force tending to pull this material out of the cell in a centripetal direction. The cell becomes stretched, the exact figures of distortion can be photographed, and upon certain assumptions, a value, at least an order of magnitude, of the surface forces which are restraining the oil, may be arrived at.

Amoeba ordinarily contains no oil. Therefore, before each animal was transferred to the special centrifuge chamber, a droplet of oil (olive or paraffin, radius 15-35 micra) was micro-injected into the cytoplasm. For this purpose the Chambers apparatus was employed. Upon centrifuging the injected globule rises and pulls out a neck of protoplasm before being torn out of the Amoeba by the buoyant force.

The following argument assumes purely surface tension forces acting at a liquid interface. However, there is reason to believe that if it is a very thin elastic membrane that we are dealing with at the cell's surface, the relationship would not be greatly altered.

Consider a sphere of liquid A (comparable to the Amoeba) surrounding a smaller sphere of liquid O (oil), the two being non-miscible. The whole is immersed in a third liquid W (water). The densities (P) are such that $P_O < P_W < P_A$. Under centrifugal force O rises and pulls out into a neck of A, being restrained by the surface film. When the stretching progresses until the diameter D of the neck equals the diameter of the droplet, the figure becomes unstable and the process of pinching off commences. At this moment the force restraining the oil drop may be considered equal to the force tending to displace it i. e. it may be supposed that:

$$Pi\ DT = Vo\ dP\ CG$$

where D=diam. of the neck (cm.), T=tension at the interface A/W, Vo=volume of the oil, dP= difference in density, W-O, and C=centrifugal force translated into dynes by the gravitation constant G. Note that two experimentally variable factors are on hand. The value for T may be arrived at by using small injected oil droplets, or large ones; and by employing different oils, the density differences may be altered. As has been said, if it is a thin, elastic membrane instead of a simple interface with which we are concerned, the relationship should be substantially the same, and an order of magnitude at least should be derived.

Both *Amoeba dubia* and *Amoeba proteus* were used and olive as well as paraffin oil employed in each case. *A. proteus* proved very resistant to the centripetal displacement of the oil drops. Its surface layer is at least 30 times as strong as that of *dubia*. Indeed at the highest speeds available neither olive nor paraffin oil could be torn out of this species. This result is in line with the observations of several previous workers using other methods.

For *A. dubia*, the values determined for T, if we discard the few observations where the oil was displaced from the cell very quickly, range about 1-3 dynes per centimeter. Probably the lowest figure is a maximum since the time factor can not be neglected. At each step, as the speed of centrifuging was increased, about 4 minutes was allowed to determine whether enough force for complete displacement was being used. There is always the possibility that a particular globule might have been torn out at a certain speed if a longer time had been allowed for overcoming viscous resistance. These low values for *A. dubia* are quite in line with similar determinations previously made by Harvey for Chaetopterus and Arbacia and with Cole's Arbacia results. If the surface has elastic properties we, of course, measure the region of the elastic limit and the tension for the unstretched condition must be somewhat less.

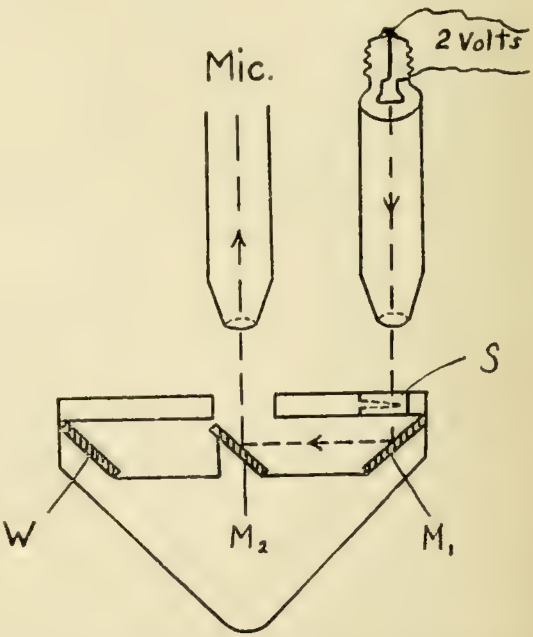
During the course of the above determinations several important secondary observations were made as regards the process of stratification at high speeds and the movements of formed bodies in *A. dubia* under centrifugal force. A complete report of the work will appear in the August issue of the *Journal of Comparative and Cellular Physiology*.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 12.)

THE BEAMS AIR TURBINE FOR BIOLOGICAL CENTRIFUGING

Dr. E. Newton Harvey
Professor of Physiology, Princeton University

It is possible to adapt the microscope-centrifuge principles to the Beams[1] ultra-centrifuge, an air driven turbine by which forces approaching one million times gravity can be attained. This scheme is the simplest possible arrangement and has worked out remarkably well, in fact far beyond expectation. No lenses but only mirrors revolve. Two stellite mirrors are mounted on Beams' rotor in such a position that the image of the object on a special slide is brought to the axis and reflected into a microscope mounted above and on the axis of the rotor. The illumination is a narrow image of the filament of a straight filament tungsten lamp thrown on the material to be observed parallel to a radius of rotation. A relatively large movement at the circumference becomes a very small movement when the image is brought to and observed on the axis of rotation. While the whole field of view is not perfect, the center is good enough for all practical purposes. The magnification of this scheme is limited by the working distance of the objectives; x5 to x7 objectives can be used giving with x20 oculars, 100 to 140 diameteres. The centrifugal force attainable by means of the Beams' rotor is limited only by strength of materials, and for microscopic observations by this method, is determined by the strength of the glass container of the living cells. This might be put at 200,000 times gravity. Such an arrangement should be particularly useful for determining molecular weights of substances by the method of sedimentation, for observing movement of materials in highly viscous cells and for observing the change in shape of living cells due to the stretching forces of light and heavier material. From such observations one is frequently able to gain an idea of the surface and other forces which counteract distortion.[2] Rotors may be built that will hold four capillary tubes for cells and tissues. In order that a cell may not be completely crushed by forces thousands of times gravity, it is necessary to adopt the expedient of suspending the material in a medium of graded density, so that the cell comes to lie in a stratum of equal density, and is thereby perfectly



A DIAGRAM SHOWING THE PRINCIPLE PARTS OF THE MICROSCOPE-CENTRIFUGE.

cushioned against crushing. Starfish and Cumingia eggs have been pulled in two with ease in this apparatus.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 9.)

[1] J. W. Beams, "Rev. Sci. Inst.," 1, 667, 1930: "Science," 74, 44, 1931. Dr. Beams and Mr. Weed, of the University of Virginia, have constructed one of the rotors with stellite mirrors which works perfectly.

[2] E. N. Harvey, "Biol. Bull.," 60: 67, 1931; 61: 273 1931.

THE RELATIVE DEGREES OF DIFFERENTIATION OF THE MATURE ERYTHROCYTES OF VERTEBRATES

Dr. Alden B. Dawson,
Associate Professor of Zoology, Harvard University.

During the differentiation of the vertebrate erythroblast a series of striking changes occurs. Some of these are readily demonstrated in fixed and differentially stained preparations, while others are adequately revealed only by the more delicate methods of supra-vital staining. Most of these changes are common in a greater or lesser degree to the erythrocytes of all vertebrates but in the mammals an extreme degree of specialization is encountered, where all cellular inclusions, including the nucleus, disappear.

The changes in cell size, in nuclear-cytoplasmic ratio and in chromatin content and pattern of the nucleus, and the loss of cytoplasmic basophilia and increase in hemoglobin content can be followed in ordinary stained smears. However, when supra-vital dyes are employed many additional features of the differentiating erythrocyte are brought out. Discrete, so-called vital granules are easily demonstrated by the common basic dyes (neutral red and brilliant cresyl blue) in all maturing red blood cells. These vital granules are present in characteristic numbers and patterns for the different species. In addition secondary, induced granules may also appear in such cells, the concentration of the dye, the age of the preparation, the brilliancy of the illumination and increase in temperature being effective as formative factors, influencing the rate and manner of their formation. Moreover, with higher concentrations of the dyes the red cells may also exhibit elaborate patterns of reticulation. These reticulation patterns are apparently derived, through a reaction with the vital dye, from the basophilic substance which occurs diffusely in the cytoplasm of the erythrocytes. Mitochondria, too, are brought out distinctly by the application of Janus green B. Besides these cytoplasmic components of the red cell, the nucleoli are strikingly demonstrated when brilliant cresyl blue is used in sufficiently high concentrations to stain the nuclei a uniform pale blue. The nucleoli then appear as dark blue-purple bodies.

Accordingly there are ten features of the maturing erythrocyte which attract the attention of the observer, but not all are of equal value in determining the relative degree of differentiation attained by the mature erythrocytes. In all cases the mature cells acquire a uniform size typical of the species. The nuclear-cytoplasmic ratio changes, the nucleus becoming condensed and acquiring a characteristic chromatic pattern. The basophilia of the cytoplasm is eventually replaced by eosinophilia and the hemoglobin concentration rises to a maximum for the species. None of these features, however, can be used as complete criteria of the degree of differention attained. That is, in ordinary stained smears the mature nucleated erythrocytes of all vertebrates look essentially alike. The shape and size of the cell and of its nucleus and the concentration of hemoglobin are characteristic of the species and not directly dependent upon the relative degree of differentiation.

The progressive loss of basophilia is, however, a mark of approaching maturity and can be directly correlated with the amount of reticulation present in the cell, but in various vertebrates after all basophilia has disappeared the amount of persistent reticulation demonstrable with brilliant cresyl blue is frequently considerable. In other words, in fixed and differentially stained smears the residual basophilic substance may be completely masked by the eosinophilia of the hemoglobin and its persistence may be detected only when it is precipitated and aggregated by the action of the vital dye.

In young red blood cells the mitochondria are usually granular, numerous, and scattered throughout the cytoplasm. In mature cells they tend to become filamentous and are always closely applied to the surface of the nucleus.

It is practically impossible to make any generalizations regarding the vital granules, as their history in the different species is a variable one. However there is a general tendency for the number of vital granules to be reduced as the cells approach maturity and in many cases they may disappear before maturity. The appearance of secondary or induced granules in erythrocytes following exposure to vital dyes has a very limited, if any, relation to the degree of differentiation attained. The amount of reaction obtained is very variable and appears to depend on factors inherent in the erythrocytes of a given species. It is not specifically related to the degree of differentiation at maturity. The nucleoli, however behave in a more uniform manner and are progressively reduced in size as the cells mature, eventually disappearing in many vertebrates.

Of the many possible criteria of differentiation that have been discussed the degree of persistent reticulation has been found to be the most delicate and consistent, and on this basis the several classes of vertebrates are arranged in the following ascending order of relative differentiation attained by their erythrocytes at maturity: amphibians, reptiles, fishes, birds and mammals. This arrangement is also supported by the behavior of the nucleoli, which persist in the erythrocytes of amphibians and reptiles but are usually not demonstrable in the mature cells of fishes and birds. In addition, it is concluded that the presence of a large number of primary vital granules or the rapid induction of new granules may in general be regarded as supplementary evidence of a lesser degree of differentiation and the vertebrates may be arranged in this slightly extended order: urodeles, anurans, reptiles, elasmobranchs, teleosts, birds and mammals.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 19).

SPLITTING THE EGGS OF FOUR NEAPOLITAN SEA URCHINS BY CENTRIFUGAL FORCE AND THE DEVELOPMENT OF THE HALVES AND QUARTERS

Ethel Browne Harvey,
Stazione Zoologica, Naples.

There are several methods of dividing marine eggs into parts; (1) by violent shaking, (2) by cutting individual eggs, either free hand or with a micromanipulator and (3) by strong centrifugal force. Sea urchin eggs, if centrifuged rapidly in a medium in which they remain suspended, are broken into parts of definite size and content, and these can be obtained in large numbers. The eggs of *Sphaerechinus granularis*, *Parechinus* (*Echinus*) *microtuberculatus*, *Paracentrotus* (*Strongylocentrotus*) *lividus* and *Arbacia pustulosa*, the commonly occurring sea urchins of Naples, have been studied. The eggs of these species (except Parechinus stratifv, as most other eggs, into (1) oil, (2) clear layer in which lies the nucleus, and (3) yolk granules. In *Arbacia pustulosa* there is in addition a layer of pigment granules at the heavy pole. In Parechinus the granular and clear layers are reversed in position and the nucleus lies among the granules. There is a granular "fifth layer" in all these eggs which stains purple with methyl green (mitochondria?). The reddish band in the Paracentrotus egg is not thrown down by the centrifugal force but is merely stretched.

When these eggs are sufficiently centrifuged they become dumb-bell-shaped and then break into two parts. In general one fairly clear cell with nucleus and the other a quite granular cell without a nucleus. There is often left a thin, connecting strand of tissue between the two half-eggs. These are fairly constant in size with any one speed of the centrifuge. It takes however, only three minutes to break *Arbacia pustulosa* at about 9000 R. P. M. (7 cm. radius) whereas it takes 30 minutes for Paracentrotus. In some cases, each half egg breaks again and we have four quarter eggs, all of quite definite size. Only one half egg and one quarter egg contain nuclei.

The size of the half eggs though fairly constant for any one speed, varies with different speeds. In three species the granular enucleate sphere is larger with high speed and smaller with low speed. With low speed, the parts often become elongate before breaking and break leaving a tail. With high speed the halves break apart as spheres.

All the half and quarter eggs can be fertilized and form good fertilization membranes just like the normal eggs. This follows the contour of the surface even along the connecting strand between the half eggs. There is a tendency for the dumb-bell shaped egg to slip back in the fertilization membrane soon after it is formed, becoming more nearly spherical. This must indicate a decrease in viscosity just following the formation of the fertilization membrane before the increase in viscosity characteristic of fertilized eggs.

In the nucleate half and quarter eggs, the stages leading to division are as in the normal egg except that no astral rays are visible in the living egg in areas free of granules. Regular divisions into 2, 4, or 8 equal cells leaeds to a typical blastula. Often a gastrula is formed which develops a skeleton (often rudimentary) and pigment but it (in Sphaerechinus) remains almost spherical without developing the arms characteristic of a normal pluteus.

In the enucleate half and quarter eggs, the sperm aster forms, then the sperm nucleus enlarges. The aster divides giving the characteristic "streak" stage, then the amphiaster forms and the egg divides, if spherical, into two equal cells; if aspherical, across the short axis unequally. By subsequent divisions typical blastulae are formed and then gastrulae, many of which (in Sphaerechinus) acquire skeletons and pigment and often become typical dwarf plutei with arms. These merogonic or ephebogenetic larvae are more viable and more normal (in Sphaerechinus) than the larvae from the nucleate half eggs.

Of special interest are the eggs which are broken into two parts with a connecting strand between and subsequently fertilized. Either one or both parts may receive a sperm; and both parts may develop independently, or either part may develop without the other. The enucleate sphere probably does not develop unless it receives a sperm independently of the other sphere, although a fertilization membrane may be formed around both. In one batch of eggs of Paracentrotus, the eggs constricted into three parts of very definite size instead of two, and each part received a sperm and developed.

A few experiments were done in fertilizing the half and quarter eggs of one species with the sperm of another species. In general it was found that crosses that could not be made with normal whole eggs could not be made with half eggs either nucleate or enucleate nor with the stretched elongate whole eggs. Crosses that could be made with normal whole eggs could be made with the enucleate half as well as with the nucleate half and in about the same percentage as the normal egg. Very good cleavages occurred in the cross between Sphaerechinus (female) x Parocentrotus (male) with all types of half and quarter eggs. Some of the enucleate halves were raised to plutei with skeletons.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 5.)

REVIEW OF THE SEMINAR REPORT OF ETHEL HARVEY

Dr. Robert Chambers

Professor of Biology, Washington Square College, New York University

That centrifugal force will divide echinoderm eggs into portions was noted long ago by Lyon. Apparently the conditions necessary for this force to cause a fluid, spherical egg to divide in two include the presence of materials some of which are lighter and others, heavier than the main mass of the cell-contents. These two sorts of material collect at the centrifugal and centripetal poles respectively, and the resulting pull causes the deformable egg to be drawn out into an ever-elongating cylinder which finally breaks into two or more portions in accordance with known physical laws of fluids.

The method lends itself well to various developmental problems and we are glad that Dr. Ethel Harvey has undertaken to use it.

Of interest is her finding that the pigment zone in Paracentrotus is not displaced on centrifuging. The pigment in this region appears to be peripheral and its non-displacement argues for a relatively high viscosity of the cortex. The fact that this region can be stretched or otherwise distorted suggests interesting possibilities of attempts to modify the relation of this region in cell lineage.

THE PART PLAYED BY DIFFUSION POTENTIALS IN THE ORIGIN OF CONCENTRATION POTENTIAL DIFFERENCES ACROSS FROG SKIN

Dr. Margaret Sumwalt, Dr. W. R. Amberson, and Eva Michaelis

Consecutively: Assistant Instructor of Physiology, University of Pennsylvania Medical School; Professor of Physiology, University of Tennessee and Research Assistant in Physiology, Columbia University

When frog skin separates two different concentrations of a KCl solution, a potential difference is measurable across it, which we may name, from its origin, a membrane concentration potential. If both solutions are approximately neutral, the more dilute solution is positive relative to the more concentrated. This direction of polarity, according to certain generally accepted rules of interpretation, signifies that positive ions traverse the skin more readily than negative ions.

When no membrane separates these two different concentrations of a KCl solution, the potential difference which arises across the liquid boundary is negligibly small, since K and Cl ions in free diffusion migrate at very nearly equal rates. The membrane concentration potential is greater than this free diffusion concentration potential probably because the membrane hinders the diffusion of anions more than that of cations. Amberson and Klein have shown that this hindrance offered specifically to the penetration of anions in the case of frog skin is probably due to a preponderance of negative charges on the walls of its pores. When sufficiently acid solutions are applied to the skin to change from negative to positive the charge borne on its pores (as shown by electroendosmosis), it then becomes more permeable for anions than for cations. Therefore, in a measurement of membrane concentration potential in acid solutions, the sign of the dilute solution is negative.

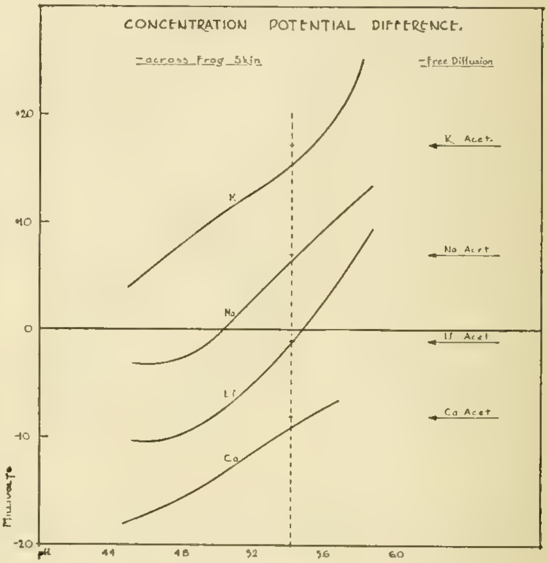
We have undertaken to determine a quantitative relationship between free diffusion potentials and membrane concentration potentials across frog skin. We ventured to predict that at some particular hydrogen ion concentration where the charges on the pores of the membrane are at a minimum, the membrane influence on ionic diffusion might be so far withdrawn that the concentration potentials measured would be identical with free diffusion potentials. At this pH value, then, concentration potentials across the frog skin with K, Na, Li, and Ca salts of a common anion should be at least in the same order as free diffusion potentials, and possibly of like magnitude. The anion chosen for these experiments was acetate.

Measurements of free diffusion potential were made across a flowing liquid junction between acetate buffer solutions which were always 0.1 and 0.01 M with respect to salt, though adjusted to various pH values by variations in their acid content. Free diffusion potentials were constant within 1.0 mv., throughout the pH range of 4.4 to 5.8; and are therefore plotted as simple straight lines at the right of the figure. The values obtained at pH 5.4 were as follows: K, 17.0+; Na, 7.0+; Li, 1.0—; Ca, 8.0—. The units are millivolts, and the sign is that of the dilute solution.

Measurements of membrane concentration potential were made with solutions which, with respect to electrolyte content, were the same as those used in the study of free diffusion, but all were made up to be approximately isotonic with frog saline by the addition of dextrose. In order to obtain concentration effects of any magnitude it is necessary to apply the more dilute solution to the outside of the skin, and to apply it afresh just before each measurement of electromotive force. From the potentials obtained between dilute and concentrated solutions must be subracted the very much smaller potential obtained when solutions of equal concentration are applied to both sides of the skin. The difference is the potential due to concentration effect, i. e. the membrane concentration potential.

The four curves in the left hand part of the figure show the membrane concentration potentials obtained. In K acetate, throughout the pH range studied, the dilute solution is positive to the concentrated, though the magnitude of the potential difference diminishes with increasing acidity. (The experiments of Amberson and Klein show reversal in this pH range with the *chloride* of K.) In Ca acetate on the other hand, the dilute solution is always negative, and increasingly so with acidity. The curves for Na and Li lie between the extremes of K and Ca and closely parallel to them. That for Na crosses the line of zero potential at about pH 5.0, for Li at about pH 5.5.

If we assume that the sole influence of the membrane on ionic diffusion has been by reason of charges on its surfaces and that there is one pH value where those charges are at a minimum, we may infer that pH value from the figure, as the point where the concentration potential with Li acetate equals its free diffusion potential. An ordinate erected at this point intersects the curves for concentration potential with the other three salts within hardly more than one millivolt of the respective free diffusion potentials of those salts.



CHART

It may be concluded, therefore, that at a certain pH value, between 5.4 and 5.5 the influence of the membrane on ionic diffusion seems to be absent, presumably because the charges on its pore surfaces are at a minimum. At that pH the relative rates of ionic migration are the same as in free diffusion, and membrane concentration potentials are therefore practically identical with free diffusion potentials. At other pH values, the membrane exerts an influence which favors cations in relatively alkaline solutions, anions in more acid solutions.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 12.)

LEARNING AT ROLLINS COLLEGE

On Sunday afternoon a large group of people came out to Penzance Point to hear Mr. Malcolm Forbes of Rollins College, Florida, speak about

"Modern Methods of College Education" as practiced there during the last five years.

Dr. Warbasse, in introducing Mr. Forbes, gave very briefly his ideas about education. Mr. Forbes then explained the two-hour conference system at Rollins. The classes last for two hours and meet every day. Only a limited number are in each class. (not over 25). In this way the instructor comes to really know his students, and they him. The class sits around a table and every one takes part in the discussion. The mind is thus stimulated to think in a more original and in a freer manner than is permitted in the case of the lecture system. During the period, while the other students are engaged in writing or reading, the instructor often takes an individual student into his office for a conference about his work or any other matter which may seem important at the time. Their marking system is not based upon grading papers, but rather widely indicated by checking up on a student's maturity, cooperation, initiative, mental awareness, industry and other characteristics which seem important to his super iors. There are no final written examinations. The student comes up before a committee and is orally examined in a rather informal manner. If he claims proficiency in a given subject or subjects, he may be asked any questions whatever on these subjects, and according to his replies, and his general background and intelligence, the committee decides whether or not he is ready to move on.

Mr. Forbes also discussed the advantages of this system over the old lecture methods, and in this connection, many questions and answers of a very stimulating nature were exchanged. The point of having the students mark their fellow-students came up, and several of the students present gave their views as to why this is so reluctantly done. The whole question of the relationship between the student and the instructor was considered, and was aptly expressed by Dr. Stockard, and in a slightly different way by Mrs. Lillie, as a cooperative relationship which attempts to give and take to mutual advantage.

The discussion was so very interesting that it could easily have lasted an hour longer, and one could not help feeling that a great many new and inspiring ideas had been exchanged. But one could not help feeling also that the ideas presented so well by Mr. Forbes, which are practiced so intensively in his college, are in a great many instances being carried out to a limited extent in many of the leading men's and women's colleges in the East and West right now. It was a subject well worth discussing, and one which might easily be repeated at future meetings from other viewpoints and experiences. —*V. W.*

BOOK REVIEW

Annual Survey of American Chemistry. Vol. VI, 1931. Edited by Clarence J. West. 35 + 573 pp. Chemical Catalog Company, Inc. May, 1932.

This survey reviews a variety of subjects which have engaged the attention of American chemists during the past year. Altogether thirty-seven chapters have been contributed by specialists on subjects ranging from the extremely theoretical aspects of physical chemistry to the more practical aspects of industrial chemistry. The usual arrangement of each chapter is a general review of outstanding events in the field, followed by theoretical and practical considerations. Bibliographies are given, but in many cases are somewhat too specific and limited by the particular interests of the reviewer. Judging from the amount of material presented under the headings of colloid, fermentation, vitamin, foods, etc., the trend seems broadly in the direction of biochemistry and all its ramifications. The greatest advances have been made in analytical chemistry, where, besides the increased emphasis on the use of organic complexes, the application of physical methods such as the X-ray, have done much in the solution of problems of chemical structure. Much of the industrial research gives the impression that the solution of practical problems has far outstripped the theoretical. The survey is not critical and does not attempt to correlate any of the facts.—*Dr. Edwin P. Laug.*

THE M. B. L. CLUB CONCERTS

The Club-house Concerts on Wednesday evenings are continuing to meet with the popular approval of those attending. There is still room for more, however, and it is hoped that this week will see a full house. The program is to be a particularly interesting one, for Mr. Greenough has chosen from his collection of records those representing modern composers with a fine example from the works of each.

As a contrast for the more or less classical program which has preceeded this week's program, the latter should prove greatly attractive since it gives a picture of the modern trend in music. Mr. Greenough is to be thanked for making these choices possible, and the best way to show this appreciation is in the reception we accord the concerts.

THE PROGRAM

Wednesday, July 20, at 8:15 P. M.

Ravel.......................Daphinus et Clohe Suite
Gershwin...................An American in Paris
Rachmaninoff......Symphony No. 2 in E minor

The Collecting Net

A weekly publication devoted to the scientific work at Woods Hole.

WOODS HOLE, MASS.

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Assistant Editors

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Vera Warbasse

Contributing Editor to Woods Hole Log

T. C. Wyman

The Beach Question
IV

At its general meeting on July 11 the Committee on Recreation Facilities spent part of its time in considering the wisdom of recommending town ownership of a part of the Bay Shore bathing beach.

The first suggestion was that the town purchase the beach rights in front of the Lots on the Northeast side of the fence. One of the lot-holders expressed his opinion concerning this point. He considered this step unwise and unnecessary, and said he felt that if the town needed a beach that it should purchase the rights for one on "Lot X" and on the neighboring one owned by Dr. Strong. This lot is the one with the bathhouses on it and is about the size of three ordinary lots. In 1928 Miss Sarah B. Fay reserved "in trust in perpetuity" the beach in front of the building *"to extreme low water mark"* for the use of "such inhabitants of that part of said Falmouth known as Woods Hole as make it their home. The people of Woods Hole have free use of the beach on Lot X through the generosity of Miss Fay. We hope that Falmouth will not make the grave mistake of spending its money for something that has been deeded to them. It is true that the deed of conveyance has been construed in such a way that the selectmen decided they could not (or did not want to!) appropriate money for its improvement. If there is real difficulty in this matter we believe that it might be overcome. Woods Hole will be better off if it assumes control of the beach Northeast of Lot X. Dr. Strong has generously left the lot bordering it free from restrictions. So for the present it is in the category of Lot X.

Possibly the consideration of a more or less hypothetical situation would make this point clear. Assume that the beach rights of an ordinary lot anywhere along the Bay Shore can be purchased for $1,000. Furthermore suppose that the town can appropriate $4,000 to purchase beach rights. There are three possible ways in which this money might be spent:

(1) By purchasing the beach rights of "Lot X" and of Dr. Strong's lot.

(2) By purchasing the beach rights of the four lots northeast of Dr. Strong's lot which belong to Dr. Brooks, Dr. Glaser, Dr. Addison and Dr. Harvey.

(3) By purchasing the beach rights of the lots belonging to Dr. Brooks, Dr. Glaser and Dr. Addison and devoting the remaining sum of $1,000 towards improving the beach in front of these lots.

We believe that the committee will not be shortsighted enough to recommend the first plan.

Neither the committee as a whole—nor any individual member of it—is responsible for, or has control over, any unsigned articles that have been printed (or that may be printed) in THE COLLECTING NET. We do not know what action the sub-committee which was appointed almost two weeks ago has taken at their two meetings; but we do know that members of the laboratory and townspeople alike are awaiting their report with considerable interest. In our opinion it should not be delayed longer; if further investigation is required a preliminary report should be made immediately to the larger committee which appointed it.

It is not impossible that members of the general committee might now have new suggestions to offer. The sub-committee could then take these into consideration in making its final report.

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
July 23	9:03	9:29
July 24	9:50	10:21
July 25	10:39	11:14
July 26	11:28	——
July 27	12:08	12:20
July 28	1:02	1:10
July 29	1:53	1:59
July 30	2:42	2:48
July 31	3:27	3:33

In each case the current changes approximately six hours later and runs from the Sound to the Bay. It must be remembered that the schedule printed above is dependent upon the wind.

ITEMS OF INTEREST

Dr. Graham Lusk, professor of physiology at the Cornell University Medical School for more than twenty-years, died on July 19 at the age of sixty-six years. Dr. Lusk was distinguished for his work in the field of nutrition, and was a member of the National Academy of Sciences.

Dr. W. F. Hamilton has been appointed to the department of Physiology at George Washington university, where he will continue his studies on blood flow. Dr. Hamilton has been professor of physiology at George Washington University, and he first began his work there in 1923. He was first trained in zoology at the University of California, and before working at Louisville he was instructor in zoology at the University of Texas and of physiology at Yale University.

Dr. L. V. Heilbrunn broke his leg last Saturday night after a supper on a beach on one of the Weepecket Islands. He was wrestling in the sand with one of his students when the accident occurred. According to the *Falmouth Enterprise* he "was said to have been demonstrating the Japanese science of jiu jitsu". The task of transferring him from the island to the motor boat was a difficult one, but the return trip to Woods Hole was made quickly. An ambulance was called and Dr. Heillbrunn was taken to the Hospital in Hyannis. The broken leg was successfully set, and his visitors find him submerged in a mass of scientific papers for he is using his enforced "leisure" to catch up with some of his own writing. It is understood that Dr. Heilbrunn will return to his home on Gardiner Road sometime this week-end.

Dr. E. U. Condon, associate professor of physics at Princeton University, visited Woods Hole on Sunday and Monday. He motored down with his wife and daughter from Cambridge where he is giving a course of lectures at the Massachusetts Institute of Technology.

Dr. E. Newton Harvey sailed for Europe on July 21 on the *Paris*. He has a leave of absence from Princeton University and will attend the Physiology Congress at Rome. Dr. Harvey will stay at the Naples Laboratory until Thanksgiving.

Mr. C. B. Crampton who was research assistant at Wesleyan University has been appointed instructor in biology at this institution.

On Tuesday a group of summer school students from the Hyannis State Teachers College, about forty in number, visited the Marine Biological Laboratory at Woods Hole. They inspected all of the buildings connected with the three institutions and took a short trip on the *Nereis*.

SCRIPPS INSTITUTION OF OCEANOGRAPHY

(Received July 16)

On Thursday of this week Director T. Wayland Vaughan went to Claremont at the special invitation of President James A. Blaisdell of Claremont College to serve as one of a small group of advisers to President Blaisdell with reference to development of a research program in his institution.

On Tuesday of this week Director and Mrs. T. Wayland Vaughan entertained a group of U. S. Navy officers at luncheon at their home. The guests included Rear-Admiral Thomas J. Senn; Captain Mayo, Commanding Officer of the *U. S. S. Ramapo*. The *Ramapo* is the naval vessel which has been conducting extensive investigations in the North Pacific in recent years.

At the end of last week Dr. E. G. Moberg returned from attendance at the meetings of the Pacific Division of the American Association for the Advancement of Science and of the Western Society of Naturalists at Pullman, Washington, and from following visits to marine stations at Nanaimo, B. C., Friday Harbor, Washington, and Seattle, Washington. In the course of these visits a conference was held at Friday Harbor between representatives of the different institutions engaged in chemical researches on sea water and in line with an earlier suggestion from the committees on Oceanography of the United States and Canada. This conference discussed plans for coordination of the chemical work of Pacific Coast Stations from San Diego northward.

Mr. P. S. Barnhart, Curator of the Museum at the Scripps Institution, reported to Director T. Wayland Vaughan at the first of this week that Captain Victor Angulo had recently made a verbal offer to him to collect temperature records, water samples and plankton samples at bi-weekly intervals at certain stations along the route traversed by his freight boat between San Diego and Mazatian, Mexico.

At the end of last week Dr. Hellmut Müller, a chemist in the laboratories of the Hooper Foundation in San Francisco, visited the Institution.

Perhaps it has been noticed that the M. B. L. Club is receiving a new coat of paint. Just at present it is a beautiful white, but it is going to have two coats, and it has not yet been decided whether or not the building will remain white or assume another color. Mr. Walter Johnson is in charge of the work, and predicts that, with good weather, the job will be completed in about twelve days. —*F. L. S.*

THE WOODS HOLE LOG

Henry Kidder, in the last Woods Hole Yacht Club race, had a harrowing experience. As he was nearing the finish line at Nobska he fell overboard while taking in the spanker. His heavy sweater managed to absorb a great deal of water and weighed him down. Consequently, it was extremely difficult for him to swim. His two younger sisters who were left in the boat could not maneouver it very well, taking quite a while to return to their disabled brother. When he was finally rescued, he said that he hoped he would never come any nearer to drowning!—*V. W.*

Dr. Bridges has had a great number of sailing experiences in his black sloop during the last few summers. Sunday afternoon he was out with a rather large party and tried to sail in the Gut of Cauco, and ran aground just off Warbasse's dock. Five years ago a knockabout of that size could easily maneouver around in the gut, but now the bottom has shifted and the whole gut is a foot or two more shallow. With the help of an observer who had a rowboat handy, Dr. Bridges managed to get his boat safely into deeper water. We hope that Captain Bridges will have better luck the next time he goes out sailing! —*V. W.*

Virginia Elmendorf and the Copeland boys have rented a "Q" boat this summer from the Garfield's. They intend to race it at the Quisset Races. Last summer they united in renting a baby knockabout which they raced in the Woods Hole Yacht Club races. Mrs. Elmendorf has come with her two children from South America, where her husband is doing scientific research.

Mr. George A. Griffin, the civil engineer and surveyor, took his degree in 1907 at the Massachusetts Institute of Technology, and not at Harvard as stated in one of the accounts printed in our last number.

Miss Charlotte Woodruff has two classmates from Smith College visiting her. —*V. W.*

Mr. Edward Norman has rented his boat, and bought an S boat which he will race in the Quissett Races.

A surprise party was tendered a young motorist as he drove his car off the S. S. "New Bedford" when it docked at Woods Hole at 9:45 A. M. Sunday morning. A state patrolman and a local officer stepped aboard his car and drove off with him. The reason for the reception is not known, but apparently the young man did not exactly welcome the attention that was bestowed upon him.—*T. C. W.*

Among the unusual pets which are kept in Woods Hole, are four monkeys belonging to Captain Ferris of the Fire Department. Placed in cages right on the main street, they have attracted wide attention from interested spectators. The first one that Captain Ferris got belongs to a most peculiar species. This monkey is of a yellowish hue, and has a long tail which is completely useless to him. Unlike most monkeys, this one cannot swing or hang by his tail at all, but he still manages to be as agile as his better-equipped associates. He came originally from the Azores, and his name is "Chico."—*F. L. S.*

Tuesday evening there was a party at "Gladheim," to celebrate the reunion of the Warbasse family. The eight members have been separated for almost ten years and had hoped to be together for at least one day before the oldest brother, Henry, would have to leave to attend to his Dude Ranch. However, Agnes was unable to attend the reunion for she left for New Bedford where on Tuesday her husky son, Peter Harvey Burger, was born.

One of the strangest boats that has been seen in Woods Hole harbor for some time arrived last week. It looked a bit like a Chinese Junk The boat is about twenty feet overall and seven feet wide. The only means of locomotion are its sails which are of heavy, black-green canvas, and which match in color the tin hulk of the boat. Oddly enough the two men on board exactly match the color of their boat; their skins, sunburned to a blackish hue, are not the usually reddish-brown of Cape Cod fishermen. The men evidently had not visited a barber shop for some time, because their matted, straw-like hair was below their ears. Even the cat on board had taken on the predominating black-green color. These men are evidently in no great hurry to get anywhere, for their boat is built for comfort and sea-worthiness. It took them one whole day to get from Quissett to Woods Hole. The cabin has no port holes at all, merely a large black stovepipe sticking out. They live on the boat all the year round, and have just come up from New York, and judging from the speed they seem to make, it must have taken them about six months. They seem to be foreigners, but their exact nationality is as yet unknown. Their boat rested a while near the Coast Guard Station, waiting for a favorable wind to bear it away to other ports.—*F. L. S.*

(Other pages of the Woods Hole Log will be found on pages 128 and 130)

THE WOODS HOLE LOG

THE FISH MARKET

Few people in Woods Hole realize, I think, what a very interesting aspect of the fishing industry is represented, on a small scale, by the Fish Market owned and run by Mr. Sam Cahoon.

Mr. Cahoon has been in the business in Woods Hole for twenty years now, and continues as enthusiastic as he was when he first started building it up. One can see that he enjoys it all, and that his own interest, as much as anything else, has contributed to its continued success. The present scope of his business gives a fair indication of the importance of this relatively small market in the fishing industry of New England in general, for by far the greatest part of his business is transacted with New York, Philadelphia, New Bedford, Fall River, Brockton, Boston and Providence. The local business in and around Woods Hole is almost negligible—only 1-16 of the fish taken in going to people there—but apparently this fact has never hampered the Market's progress in any way.

At present, the working force at the market comprises three men in the Market itself, seven men on one boat and three on another. The boats used are motor boats, and have been found to be consistently satisfactory for the kind of fishing that is done. The boats go out winter and summer, but in the winter only the larger boats are used. The length of the fishing period varies a great deal, the boats sometimes staying out as long as two weeks, while the smaller ones may return every day to deliver their fish.

Certain seasons bring in their own particular variety of fish. The most usual catches during the summer months of July, August and September, are of sword-fish; but there are also a great number of flounders, flukes, and some mackerals. The flounder runs right through the winter season, but the others do not. However the demand for lobsters is far greater than that for all the other fish combined, and is more valuable from a business standpoint. Aside from this, Mr. Cahoon does a very good business in the summer season with scallops of which he sells two entirely different kinds. One kind is known as the bay scallop, which comes in during the months of September, October and May. These scallops, under a government regulation, must not be caught at any time except during the months specified. They are found in "shoal" waters. The summer, or "sea" scallops are caught only in deep sea water, and their acquisition is not at all regulated by the government, since they are for the most part caught outside the twelve-mile limit.

There are, in the nearby waters, eleven traps set out for fish. Five of them are at Gayhead, five in Buzzards Bay and one in Lambert's Cove. Most of them are emptied daily, except on Sunday. The traps at Gayhead are left alone until they are quite full and then emptied. The whole process of fishing is quite irregularly done, for on some days no boats come in at all, and on other days as many as fifty boats unload. But in any case, the fish market is never at a standstill, as one can readily see by the bustle of activity which centers about the place at all hours of the day. I am sure that no one who is at work there is ever idle for long, and that is something to stop and think about in this day and age! —*F. L. S.*

I FOUND SOME NEW SHOPS

Last week-end while I was here I noticed that some other shops were recommended by The Collecting Net. I found a delightful coffee shoppe (Marge's) conveniently situated on the corner of Main and Depot streets. The charming orange and blue furnishings form a delightful background for the delicious meals served there. I also found that there was an excellent hairdresser back of the Western Union office, where "Suzanne" washed and waved my hair as well as I ever hope to have it done. Mr. Griffin, I have learned, is the only surveyor in town and does such a satisfactory job that there is no need for any other. I hope I will find more such shops in Woods Hole when I come back. —*V. W.*

The Falmouth Emergency Employment campaign has been crowned with success. Its organizers agreed to obtain pledges for work to be done soon amounting to $100,000. Woods Hole exceeded its quota because of the untiring efforts of Charles E. Gifford, Commander Roderick Patch, Harry Daniels, and George A. Griffin, as well as by the active work of several individuals affiliated with the Laboratory including Samuel Pond, Thomas Larkin and James McInnes. The pledges for the Woods Hole district alone have amounted already to over $12,000 and they are still coming in. If any member of the laboratory can pledge to have work done soon he should obtain a card immediately from one of the men mentioned above. In making the pledge one can "select his own contractor, employ whom he pleases and purchase wherever he pleases; and he is to make his own bargain. But, if he needs to, he may apply to headquarters for suggestions or help."

(Other pages of the Woods Hole Log will be found on pages 126 and 130)

THE WOODS HOLE LOG

COAST GUARD COMMENDED

The following is a letter which was addressed to Commander Patch at the Coast Guard Station at Woods Hole from the Chief of Police in New Bedford, commending the assistance rendered in the recent airplane disaster there.

Lieutenant Commander R. S. Patch
U. S. Coast Guard,
Woods Hole, Mass.
Dear Commander:—

This is in reference to the commanding officer of your Coast Guard boat which came to our assistance in the New Bedford Harbor on July 11, when we had a serious airplane accident and two people were drowned.

I regret I do not know the officer's name in charge of the boat. However, I want you to know that we received full and effective cooperation from this boat. As a matter of fact, they located and brought to the surface the plane which sank, and by so doing we were able soon after to recover the boats and the two persons drowned. I am sure that the people of New Bedford appreciated this service, and I certainly do, as I know what the assistance given by your men meant to this department.

I want you to feel that this department is at your service at any time. Do not hesitate to call us for any service that we may be able to render.

Respectfully yours,
SAMUEL D. McLEOD
Chief of Police.

There is one assistance report from the Coast Guard this week. On July 11, while moored at Cuttyhunk, Massachusetts, a vessel was sighted off Gull Island making distress signals at about 6:00 P. M. A Coast Guard boat immediately put out to its assistance. It reached the vessel about 6:30, and it was found to be an American gas screw C-7899 of New Bedford. A line was passed on board and the boat taken in tow for Cuttyhunk, arriving there about 7:00 P. M. Some members of the engine force of the Coast Guard boat worked on the motor and made temporary repairs which enabled the C-7899 to leave Cuttyhunk for New Bedford at 8:00 P. M. The patrol boat was the CG-149 in charge of Frank Eaton. —F. L. S.

The Bureau of Fisheries reports that there is a new boat being built for them at Providence at the present time. It is about the size of the *Asterias*, being a forty-foot boat equipped with a deisel engine. It was to be tried out on Tuesday and expected to reach Woods Hole by the end of the week. It will be used for the customary collecting trips.—F. L. S.

AT SILVER BEACH

The Theater Unit will give the first performance of Elsie Schauffler's "Peep Show", Monday evening, July 25 at Old Silver Beach, West Falmouth where it will run through the week. "Peep Show" has not been produced on any stage before but is scheduled for Broadway production next Fall.

In writing "Peep Show", Miss Schauffler has made use of a strange and exciting theme. Gorgans of the past refuse to lie in their graves, and threaten to turn pleasant green existances into petrified forests. Only courageous love can down such ghosts. Past and present lie in interesting periods, the one in the 'nineties, the other in 1905. Without the hocus-pocus of the mystery play, the playwright has devised a tense drama, comparable to "Berkeley Square."

The cast will include Katherine Squire who as Penelope Wilson will carry the burden of the play, Byron McGrath, Barbara O'Neil and Bretaigne Windust. —*J. T. S.*

PLAY REVIEW

This past week the Theatre Unit players at Silver Beach have been producing the well-known comedy "It's a Wise Child". The heroine, admirably played by Barbara O'Neil, is in the predicament of being engaged to marry an older man whom she detests. To break the engagement, she falsely tells him that she is about to become a mother. The family lawyer, with a great deal of difficulty, finally gets the girl out of her difficult situation. Joshua Logan in this part showed that not only can he direct plays (for the past three plays were produced by him) but also that he is an excellent actor. Judging from the laughter and applause which Merna Pace as the maid and Jim Stewart as the iceman received, I am sure the audience appreciated their characterizations. I felt that in this play the whole cast united together to make a well-rounded production.

—*V. W.*

LOST—Pair of wire-rimmed glasses by Virginia Fletcher. If found please return to "Collecting Net" office.

The Island Airways Corporation seems to be very successful, for last Friday they carried seven passengers on a single plane. On one day 63 were carried. When they first started their flying service, if they had 30 passengers on one day they felt it was a very profitable one. —*V. W.*

(Other pages of the Woods Hole Log will be found on pages 126 and 128)

THE COLLECTING NET

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NEURO-HUMORALISM

DR. G. H. PARKER
Professor of Zoology, Harvard University

I want to talk to you about something that has come up since my book has been published. If you look at the way in which chromatophores are controlled, you will see different schemes; for example, in such forms as crustaceans, the eye is essential. From that organ the blood picks up something and carries it to the chromatophores in distant parts of the body, inducing expansion and contraction of these organs. This is the humoral device for the control of chromatophores which has been described by Dr. Perkins, and that was reported here some years ago.

If we turn to the fish, we find the eye is again essential. Nerves of body run to the chromatophores and in some way or other there is nervous control of expansion and contraction of chromatophores. If you cut a nerve trunk, response as far as the given chromatophore is concerned, ceases in the main. The two plans appear to be opposed to each other—the humoral and the nervous. But in my opinion they are not separate but are different aspects of the (*Continued on Page* 141)

SOME ASPECTS OF THE PHYSIOLOGY OF THE HEART OF LIMULUS POLYPHEMUS

DR. W. E. GARREY
Professor of Physiology, Vanderbilt University School of Medicine

We are all familiar with Pasteur's dictum that "chance favors only the prepared mind." All physiologists have had their chance to investigate the fascinating heart of Limulus since its anatomical description by Milne-Edwards in 1873 and the more extensive studies by Patten and Redenbaugh in 1899. There were no reports of physiological studies until 1904 when Prof. A. J. Carlson undertook the investigation of this heart and published his papers—now physiological classics — as a culmination of a series of studies on the invertebrate heart. His was the prepared mind. Subsequently many physiologists in this country and abroad have extended this work, but always to confirm his experimental findings, proving that the rhythm of this heart is neurogenic, that the impulses arise in one or all of the ganglion cells of the median dorsal ganglion (and plexus) of this heart, that they are conducted by nerve

M. B. L. Calendar

TUESDAY, AUGUST 2, 8:00 P. M.

Seminar: Dr. W. R. Taylor; "Phytoplankton of Isle Royale, Lake Superior."

Dr. Conway Zirkle; "Cytological Fixation with the Lower Fatty Acids, their Salts, etc."

Dr. G .W. Prescott; "Copper Sulphate as an Algacide in Lakes and Public Water Supplies."

Dr. Albert Saeger; "Manganese and the Growth of Lemnaceae."

FRIDAY, AUGUST 5, 8:00 P. M.

Lecture: Dr. Robert Chambers; "Vital Coloration of Protoplasm."

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fibers and cause muscular contractions in the same way that contractions of skeletal muscles are caused by motor nerve impulses from the central nervous system of vertebrates. Carlson reasoned by analogy that the vertebrate heart was likewise neurogenic, but all evidence now seems to point to the conclusion that his deductions were erroneous and that the vertebrate heart is purely myogenic. The differences in the physiological responses of these two classes of heart far outweigh the similarities and definitely label the vertebrate heart "myogenic," the Limulus heart "neurogenic." A recently launched attempt of Dubuisson, following the lead of Hoshino to show that the Limulus heart is myogenic has been wrecked on the rocks of faulty technique, insensitive methods and inadequate controls. The following review will emphasize the extent of the wreckage.

Both the vertebrate heart and that of Limulus are automatically rythmic; they beat when excised from the body. The rhythm of the vertebrate heart originates in the basal part of the heart, in the mammalian heart in a definite collection of modified muscle cells called the "sinus node". In Limulus the rhythmic impulses originate in the elongated median dorsal ganglion, the ganglion cells of which are distributed chiefly from the third to the eighth cardiac segments. Removal of the ganglion brings the heart to rest. In rare instances weak contractions may still persist after this operation and may be demonstrated more clearly by distending the heart and thus increasing its excitability. The origin of these impulses can be demonstrated to be due to ganglion cells in the outlying dorsal nerve plexus. They may be located by systematically hunting for them with the end of a heated test tube; when found they respond to heat with an accelerated rhythm which affects the rate of response of the muscle which may be located several segments away. The rhythm disappears when the nerve cells are destroyed or their efferent nerve fibers cut. Impulse formation by the ganglion is incontrovertibly proven by the demonstration of rhythmic electrical changes in the excised ganglion, the action potentials of which have been recorded by Heinbecker and thoroughly studied by Rijlant in this laboratory by means of the kathode ray oscillograph.

Conduction and coordination in the vertebrate heart are effected by conduction from muscle cell to muscle cell, and the organization is such that if one fiber contracts, the entire muscular structure likewise responds according to the all or none law. The Limulus heart is very different; conduction is effected only by nerve fibers. While anatomically the heart muscle of Limulus is described as a syncytium, its physiological response shows that it is really made up of independent contractile elements.

If the muscle is directly stimulated by an electric shock, the contractile response is limited to the area stimulated and does not spread through the muscle The contraction is greater the stronger the stimulus and repeated stimuli likewise induce greater contractions than single shocks Unlike the vertebrate heart tetanus can be induced by repeated stimuli, even as few as ten per second sufficing to this end. We thus see that three characteristics of the vertebrate heart fail in the muscle of Limulus heart, viz., conduction, the "all or none" response and failure of tetanic response. The same results can be obtained by stimulating the motor nerve fibers which form the conducting bridge between ganglion cells and muscle fibers. If one progressively removes the ganglion piece meal, beginning at the posterior end, while recording the contractions of the anterior (non-ganglionated) muscle segments, there is a progressive weakening of the contractions. The operation progressively severs the nerves connecting the ganglion cell with the muscle, thus extinguishing some of the ganglionic impulses and paralyzing some of the contractile elements. I have shown that this progressive paralysis of the muscle may be induced in three stages by cutting the median dorsal nerve and the two lateral nerves which are the only motor nerves to the anterior muscular segments. Stimulation of these three nerves likewise demonstrates a partial and fractionate innervation of the musculature by each. Stimulation of each lateral nerve causes a contraction affecting predominately the ipselateral half of the muscular ring of each segment. The median nerve innervates both halves of the heart. A maximum contraction can be secured only by stimulating all three of these nerves and only by the use of rapid repetitive stimuli, thus inducing multi-wave and multi-fiber summation. By bringing these three nerves into action in succession the height of the tetanic contractions may be superimposed in three successive stages and must be due to the independent contraction of three separate groups of muscle fibers. Any one of these groups may be completely fatigued without affecting in any way the responses of the other groups. Normal contraction due to the rhythmic discharge of the ganglion is never maximal and may be significantly increased by stimulation of any one of the motor paths, the rhythmic contractions being then superimposed on the tetanic base thus established.

These hitherto unpublished results are crucial proof that the Limulus heart beat is not and cannot be myogenic as Dubuisson has claimed; and they dispose of all analogies to the contraction of the vertebrate heart which does not manifest any responses comparable to those of the Limulus heart muscle.

Stimulation of the ganglion at any point with a single stimulus, electrical or mechanical, induces a discharge of motor impulses from the entire length of the ganglion; it induces an extra systole which involves the musculature of every segment. This reaction necessitates an intimate connection of every part of the ganglion with every other part of it and shows that the ganglion at one point or another is connected by nerves with every part of the heart. The refractory period of the ganglion is very short and such extra systoles may be summed with the contraction induced by the preceding normal contraction. The normal autogenous impulse which follows such an extra systole does so at an interval slightly greater than the normal interval. This response is characteristic of only one locus in the vertebrate heart, viz., the "pace maker"; it likewise proves the ganglion to be the "pace maker" of the Limulus heart.

If we turn now to the consideration of the "pace maker" function of the ganglion, the experiments just considered indicate the possibility of impulse formation in any part of this extended cord-like structure. This is easily demonstrable by the localized application of heat to the ganglion; for example, touching the ganglion anywhere between the third and eighth segment with the bottom of a warm test tube will always accelerate the rhythm; furthermore, this result may be secured by heating a very restricted region one or two millimeters in length by means of a loop of resistance wire carrying current enough to induce the desired heating effect; stretching by means of a thread passed under the ganglion at any point will accomplish the same result. By these means we have been able to demonstrate the rhythmogenic power of every part of the ganglion and to develop a "pace maker" at any desired point. The rhythm of the entire structure is determined by that part of the ganglion having the greatest rhythmicity. Heating or treating deganglionated muscle in this way never develops rhythmic properties in it.

At this point we may ask: where is the normal "pace maker" located in the ganglion? By dividing the heart into smaller pieces by transection at different levels, Carlson demonstrated a slightly greater rate of contraction of the fifth and sixth segments. Edwards by optical means found that the fifth segment beat slightly in advance of those either anterior or posterior to it, and Rijlant, with the kathode ray oscillograph, found a like spread of the action currents in the ganglion and anterior portion of the median nerve. Both found that the conduction proceeds at the rate of about seventy-five centimeters per second. Thus the whole heart does not beat synchronously as Dubuisson claims, but there is a successive involvement of the muscle farther away from the fifth or sixth segment. The time required for this process, however, is less than one-tenth of a second, and since the actual contraction lasts for more than a second at laboratory temperatures it follows that for most of the time of systole all segments are contracting, as anyone can easily see, but only methods of precision and a skilled technique can detect and measure the velocity of a nerve impulse.

A further analysis of the ganglionic discharge can be made by a study of the electrical action potentials of the muscle nerve and ganglion. Since single induction shocks or the make or break stimulus of the constant current produces only a minimal contraction when applied to either muscle or motor nerve, but the ganglionic discharge whether normal or extra-systolic causes a sustained contraction like that produced by repetitive stimulation of the muscle or nerve, Carlson concluded, rightly, that the normal contractions are brief tetanic responses. Piper had demonstrated the oscillatory potential variations in skeletal muscles of vertebrates when activated from the central nervous system, thus demonstrating the tetanic nature of voluntary and reflex responses. Hoffmann in 1911 showed similar oscillations during the contraction of the muscle of the Limulus heart and attributed them to the tetanic nature of the responses. I have recently published electrograms which entirely substantiate this conclusion. The failure of Dubuisson and of Dubuisson and Monier to detect these oscillations is due to their failure to appreciate the fact that the salt soluion of the body tissues and fluids, equal to a 3% solution of NaCl, offers little resistance to the passage of an electric current and effectively short-circuits the lead-off electrodes, thus making the detection of slight potential variations impossible. Insulation of the tissues is necessary to success with the string galvanometer. With Rijilant's kathode ray oscillograph (1931) practically identical electrograms may be obtained on simultaneous records of a motor nerve and the corresponding part of the cardiac musculature. Since the isolated ganglion and nerve give corresponding potential changes, we have here crucial proof of the relation of cause and effect in the two processes, i. e., proof that the heart is neurogenic and that the contraction partakes of the nature of a neurogenous tetanus. The string galvanometer follows the muscular changes quite faithfully and with amplification will indicate the nerve changes. The examples thrown on the screen show that there is a sharp initial potential change followed by a succession of major oscillations at the rate of about ten per second at room temperature, about twelve of them for each contraction. Superimposed upon these and markedly distorting their regular form are minor waves. These indicate the asynchronous contraction of the contractile elements and constitute further evidence of the fractionate character of the muscular innervation already discussed. The precise form of the electrogram is variable depending upon the position of the lead-off electrodes and the sequential relation of the physiological processes under each. The initial deflections may be made monophasic or diphasic at will.

The long duration of the tetanic discharge is matter for thought and speculation. One may conceive the ganglion to be made up of a series of cell groups which initiate the major oscillations, the minor oscillations being caused by another type of cell more discretely disposed, but we still are faced with an interesting problem. Since the conduction rate would involve the whole ganglion within one-tenth of a second or less why does the ganglionic discharge and muscular contraction continue for more than a second? It may be that once the discharge is started the ganglion cell continues in action for this length of time; on the other hand, there may be a reactivation of the pace maker cells by those subsequently involved through recurrent pathways and the establishment thus of a succession of circulating impulses within the ganglion. The idea has intriguing possibilities in the eplanation of many processes in the central nervous system of vertebrates—it awaits the test of some ingenious investigator.

Let us turn now to the consideration of the processes which underlie the development of the rhythm. An indirect attack may be made by a study of the effects of different temperatures. Subjecting the muscle alone, for example, the denervated heart or the anterior segments which contain no effective rhythmogenic nerve cells, to different temperatures never develops a rhythm in the former instance or alters the rhythm in the latter; there is no myogenic rhythm. The procedure merely alters the excitability and force of contraction whether in response to artificial stimulation or the normal ganglionic impulses. The optimal temperature for the muscle is around ten or twelve degrees, Centigrade; the muscle enters reversibly into heat paralysis at about 32°. The ganglion, on the other hand, shows a progressive increase in rate of impulse formation up to 40° C. or higher and is correspondingly slowed by cold, not ceasing its action even at —2° when the fluid about it is in a frozen state. In plotting the rate against temperature I have found that an S-shaped curve is obtained. When the temperature coefficients (Q_{10}) are calculated, they prove to be uniformly greater than 2 in the normal range of temperatures, very large, even 12 at low temperatures, gradually decreasing in the higher ranges of temperature. Such temperature coefficients are highly presumptive evidence that the underlying process is chemical in nature as one would expect, and I naturally turned my attention to oxidation processes as the energy source of the dynamic variations. Carbon dioxide, an end product of oxidation, is evolved from the ganglion as Tashiro had shown. The rate of its development at different temperatures was tested by the change in the hydrogen ion concentration of a non-buffered, isotonic, balanced salt solution, and I found that the curve was identical with that of rate changes. The two phenomena showed identical temperature coefficients. Thus was established a quantitative correlation between the two processes which pointed to the relationship of cause and effect. All agencies tested showed that acceleration was accompanied by increased evolution of carbon dioxide, while depression of the ganglionic rate of impulse formation depressed the production of carbon dioxide. A similar relationship holds for the utilization of oxygen as shown by Miss Dann and Miss Gardner, although the quantitative aspects of this work are still open for investigation.

The antithesis of stimulation viz., inhibition, can be investigated and fits in admirably with the chemical phases of this study. The ganglion can be inhibited either by the stimulation of afferent inhibitory nerves or by direct stimulation, for in a study with Professor Knowlton it was found that while slow rates of stimulation of the ganglion cause a response (extra systole) to each stimulus, increasing the rates to about twenty per second causes a gradual lapse to complete inhibition. This is a condition in which the ganglion is relatively or absolutely inexcitable—the muscles are simply "arrested," *not inhibited;* they remain normally excitable to artificial stimulation. Time will not allow further consideration of the interesting inhibitory phenomena beyond the statement that carbon dioxide production and oxygen consumption by the ganglion fall far below the normal; the chemical processes which we conceive to be at the seat of normal impulse formation are suppressed; whether there is a development of a humoral inhibitory substance remains an open question. I cannot close without alluding to the fact that the ganglion of Limulus can continue to function for a long time in an atmosphere of hydrogen or nitrogen (Newman) and after treatment with cyanides. The ganglion can then function anaerobically and we picture to ourselves some chemical mechanism possibly like that in the anaerobic activity of muscle and nerve in which lactic acid and carbon dioxide are formed, with the concomitant changes in hexose phosphate and creatine phosphate, the oxygen being needed in the recovery processes. Such speculation opens an interesting field for investigation which promises results in the interpretation of the dynamics of the nervous system of higher forms.

All of the evidence presented in this brief review point clearly to the neurogenic nature of the beat of the Limulus heart. The characteristic properties are all those of nerve cells with nerve conduction to muscle which in all its reactions is like the skeletal muscle of higher forms and in no way like that of the vertebrate heart.

(Abstract of a lecture with lantern slide demonstration delivered at the Marine Biological Laboratory, Woods Hole, July 22, 1932.)

NEURO-HUMORALISM

(Continued from Page 137)

same general plan. In the shrimp, and also in the amphibia, we have short nerve arm (the eye or the eye stalk) and a long humoral arm; in the fish and reptile there is a long nerve arm and short humoral one. This is what is meant by neurohumoral activity. Both types of response occur; the operation begins as a nervous one and ends as a humoral one. In crustaceans and amphibians it is chiefly humoral; in fish and reptile it is chiefly nervous. The two schemes are, in reality, the same.

The two schemes have been contrasted in that in the humoral, the animal responds as a whole; in the nervous the reaction may be local. In the case of nervous control a local action is possible; in that of humoral control, a general change takes place. This is not quite true, however. It is known that fish can change their color pattern, whereas most other animals cannot. In the case of the flat fish the reaction is extremely local. If they are placed upon a background of coarse checkerboard pattern, they respond roughly by coarse spotting; if placed upon a fine checkerboard pattern, a fine pattern results. If you take the blood from a dark fish and inject it into a light one, there comes at once a dark spot in the region of injection. How can this reaction be accounted for? Fluid conditions of the body are different. We think of circulation as running with extreme rapidity; lymph is carried with considerable rapidity. Therefore an animal ought to show general uniformity, but it does not; there may be great diversity. This diversity is not to be attributed to blood but rather to cell sap, or tissue sap, which moves with much greater slowness and so allows for these conditions. In humoral conditions we have possibilities for local reactions as was implied in the idea of nerve control. It might be similar to the control of muscle—a single muscle may work as an isolated element. Some flat fishes can make these change on their surface almost like muscles, due to the control tissue juices, possibly to sluggish lymph itself.

Some weeks ago my finger was bitten by an insect. It was surprising how long it took for the poison to spread—almost two weeks for it to reach the root of the finger. It spread in some slow, sluggish way, not through the blood or lymph, but through epithelium and the skin. In the feeding of coelenterates there must be a similar slow passage of digestive products; there is a passage from living entoderm to ectoderm, a slow passage of tissue juices.

Cell saps and tissue saps seem to be of extreme importance in neuro-humoral responses. Through these devices we can obtain in fish different local responses in the skin and at the same time these responses are the result of humoral action. This action does not necessarily involve the whole animal but may be local in its effects.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 19.)

THE FACTOR WHICH DETERMINES THE ORIENTATION OF THE OUTGROWING NERVE FIBER

DR. PAUL A. WEISS
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Nerve fibers arise as outgrowing processes of nerve cells. Their course is by no means an irregular or haphazard one, but a definite pattern seems to be established during development, both in the central and peripheral connections. The question arises as to how such a definite orientation of the fibers can be brought about. Mechanical, chemical, electrical and metabolic factors have been claimed, and partly been proved, as directing influences. Results of recent experiments, however, seem to emphasize that the *ultimate* mechanism in the orientation of the nerve fiber is a certain mechanical organization of the environment through which the fiber travels. The space between the various tissues which the nerve fiber has to bridge is filled by a gelatinous "groundsubstance." The elements of this substance, "ultramicrons," "micellae," are bar-like in shape. It is well known that any definitely oriented action on such colloidal matter by physical forces can create a definite parallel orientation of the micellae. Now, if the outgrowing nerve fibers were bound to use these definitely oriented aggregations of micellae as a kind of rails, every action that causes orientation of the ground-substance evidently would bring about a correspondingly oriented course of the nerve fibers.

In order to prove experimentally this possibility, a method originally developed by the author for analyzing the factors at work in the formation of functional structures in the connective tissue has been used. This method consists in cultivating "in vitro" tissue fragments in a colloidal medium on which differential tensions are acting in definite directions. The medium is a thin membrane of a mixture of blood plasma and embryonic juice coagulated in a tiny glass frame of a given geometrical form. The distribution and direction of tension in these membranes can be determined, and earlier experiments of the author have shown that connective tissue cells follow, in their growth the lines of tension. It has been shown, too, that the factor controlling the growth direction is not immediately the tension, but is the orientation in the plasma medium evoked by the tension. If, now, the experiments are repeated with nerve cells instead of connective tissue cells, the outgrowing nerve fibers again follow the lines of tension, indicating their being passively oriented by the orientation of the micellae imposed upon the plasma medium under the influence of tension. Thus, it is the structure of the medium that is *ultimately* responsible for the directed growth of the nerve fibers. Tension, like all kinds of other directive influences, of course, can cause orientation of the micellae in the ground-substance. Among those influences are chiefly electrical fields and currents of liquids, the latter being probably caused by local differences in the metabolic activities of different parts of the embryo. A center of high activity causes currents in a radial direction and as a consequence a corresponding arrangement of the micellae. On this basis, the fact that nerve fibers are attracted by developing organs (Detwiler) finds an easy explanation, as developing organs obviously are centers of higher activity. A similar explanation holds for the formation of connecting fiber tracts between centers of increased rate of differentiation within the central nervous system (Coghill). Besides, a great many facts of normal and experimental development of nerves can be explained on the basis of the results, as outlined above. It must, however, be remembered that these results, have so far been obtained only on nerve fibers growing outside the organism, and that it remains for future investigation to decide whether or not the conditions within the organism, as far as the orientation of nerve fibers is concerned, are comparable to those "in vitro."

(This article is based on a seminar report presented at the Marine Biological Laboratory.)

REVIEW OF THE SEMINAR REPORT OF DR. WEISS

DR. A. P. MATHEWS
Professor of Biochemistry, University of Cincinnati.

Many other men in the laboratory could comment on this interesting paper of Dr. Weiss better than I could. For, although I have long been interested in the general problem of which this is part, I know nothing of the factors which determine the outgrowth of nerve fibers to particular end organs. My comment will of necessity be of a very general nature and deal only with the broad features of the problem presented.

There are at least three, and I believe four, forces which may act to orient molecules in the manner suggested by Dr. Weiss. If a molecule possess an axis of electrical potential it may be oriented by electrical force; if it possess an axis of magnetic potential, it may be oriented by magnetic force; and if it possess a marked axis of form, as Dr. Weiss suggests and as has been shown by X-ray analysis to be the case in many protein and carbohydrate molecules, and as the power of crystallization also shows, then it may be oriented by mechanical force. So much we learn from physics. But there is a fourth possibility which physics has not yet considered, a possibility which I believe actually is the case in living matter and is the determining factor of vital organization. This is the possibility that there is a potential correlated with time, just as the other potentials mentioned are correlated with space. This we may call time potential, although, of course, it does not appear to us as time, which is the passive presentation of the fourth extension, but as a power of action. Let us suppose that there is this power of action of time and what I have called 'time potential.' Then those molecules which have a well marked time potential axis can be oriented, and are oriented, in any field of time force, such as the great time field of our universe. It is this orientation which produces the peculiar and unique organization of that matter called living. Living things of every kind, I believe to be time organized, and to be 'chronals', the analogue of crystals which are space organized.

But this is an opinion which, so far as I know, is held by myself alone. The physicists have not yet recognized that there is such a thing as time potential and time force, although they recognize that there is a form of energy, i. e., inertia, different from ordinary, or space, energy. But they have not yet recognized that the force in inertia is time force, a force of endurance, and that time force is but the product of two elements of time potential, just as space force is the product of two elements of space potential, for both space and time certainly have their potentials, or activities.

The biologist, therefore, if he be a slave to the conceptions of the physicist, as he generally is, not daring to call his scientific soul his own, has only the first three forces enumerated at his disposal when he tries to explain living phenomena, and naturally he makes the greatest possible, but futile, use of these. He does not usually stop to think that the physicist has arrived at his conceptions of things by a study of only three of the four kinds of organisms known. That is, he has studied mechanical, electrical and magnetic organisms. The biologist studies the fourth kind, living organisms, and he should do for these what the physicist has done for his, imitating his methods but not adopting his conclusions as holding for living organisms. So far, however, the biologist has done little more than to discover that living organisms are neither of the other three physical forms, nor a combination of the three. He does not yet clearly recognize that living organisms have a different kind of activity from the others, a different form of potential, living potential, which is, I believe, nothing but the activity aspect of time. And that these organisms have a different form of force, namely, vital, or time, force.

But leaving on one side these general considerations, the truth or error of which the future will reveal, let us put ourselves in the position of a growing nerve cell in one of Dr. Weiss' cultures. This cell is an individual. I believe it to be a mental unit or individual, for this is what I am, and I must judge other living things by myself, the living thing I know most completely. Certainly the nerve cell is an individual or unit, whatever be the nature of its unity or individuality which is secured by its organization,—that organization of which we seek the nature. Parenthetically it may be observed that if it be not a mental unit, the biologist can give no explanation of any kind for his own mentality. But let us suppose that I am a nerve cell in Dr. Weiss' medium. What would determine my path in life?

There are two possibilities: I may be a free agent and my path be determined by my own powers of action: by my will and by my affection. Or I may be constrained to follow a certain path by outer circumstances. Some such circumstance, for example, may have constructed on each side of me high walls, which I cannot climb. I can go but in the one direction—between these walls. This leads me ultimately to a place where I may be of use to the community by entering into relationship with what I find at the end; something upon which I may now impose my will or my affection, and thus control it.

According to Dr. Weiss' very interesting suggestion, this mechanical constraint is what occurs in the body. Mechanical traction orients the obstacles (molecules) which lie athwart my path, so that they now lie parallel with each other thus opening vistas down which, if I be a nerve fiber or a connective tissue cell, I may stroll without difficulty; and if I stroll at all I am constrained to stroll there. The orienting force may be a mechanical tension on the medium; or it may be a current of fluid in it.

It may be asked why the same force, if it be a tension, may not also act on the molecules of the nerve cell itself and thus act directly in place of indirectly? I imagine Dr. Weiss would reply that protoplasm molecules do not have a definite form axis, for if they did they would readily crystallize, and this they do not do. Moreover it is obvious, if my theory be correct that these molecules of living matter are peculiar in having a definite time polarity and are organized by that, it would be a great drawback to them to have in addition a form polarity, since this would tend to organize them as crystals rather than as living organisms. Living molecules, if they be time polarized, and oriented by the great time field of the Universe, so that they form living organisms, must not have a marked polarity of any other kind. Surely we are the children of Chronos, who is the father of everything. But it is a wise child who knows his own father! And few are wise.

In other words the problem of the growth of the nerve fiber toward its end organ may be as complicated as any other vital problem and as complicated as that of human behavior; and experience teaches us that we must be constantly on our guard against the conclusion that any one factor is exclusively concerned in any vital process; and in particular that that factor is mechanical, chemical, or physical. For in the last analysis there is no casuality in the objective, the scientific world, using the word casuality in the sense of the efficient cause of Aristotle; since such cause is metaphysical and belongs in the internal, or mental, world. We must accordingly turn to the mental factors for a final explanation. But when we do so we abandon science.

The way out of the difficulty, which thus besets us as biologists, is to be found, I believe, in the objective and hence scientific study of the time relationships of living things; since the time dimension is perceived both objectively and subjectively and so has relations to both mental and physical. It is that dimension which connects the internal, or mental, with the external, or physical, world.

But all this is for the future to work out. Meanwhile such work as that of Dr. Weiss is of great value, for if living things be time machines, nevertheless they are in a mechanical or space world which interplays with them at every moment. The analysis of these physical factors of the environment is highly valuable and, indeed, a necessary preliminary to the more fundamental study of tomorrow.

NERVE CONDUCTION VELOCITY AND EQUILIBRATION

Dr. R. W. Gerard
Associate Professor of Physiology, University of Chicago
and W. H. Marshall

Though older work demonstrated that nerve could not be so fatigued by continued stimulation as to lose its ability to conduct, much evidence points to a diminution of activity. As a nerve is driven by more frequent stimuli the response becomes less, at first rapidly but later slowly to some equilibrium level. The exact position of this level, at which exhaustion and recovery keep pace, is determined by the balance in the tissue of the chemical changes associated with conduction and recovery; being lower for more frequent stimulation, higher for less. The change in activity from one equilibrium level (e. g. resting) to another has been called equilibration, and associated with this are: decreased heat production and oxygen consumption per impulse, prolonged refractory period, increased threshold (rheobase) and lessened initial action potential.

From theories of the nerve impulse now in favor it would be predicted that with an increased rheobase (25%) and a somewhat lessened action potential, the velocity of propagation should be decreased by over 25% in an equilibrated as compared with a resting nerve. This follows since conduction rate is determined by the time required for an action current from a given active region to electrically excite a contiguous resting one.

Experiments to determine velocity changes during equilibration were performed on dog phrenic and bull-frog sciatic nerves. The isolated tissue was stimulated near one end and action potentials led off at a convenient distance, through an amplifier, to a cathode ray oscillograph. A time record of 4000 per second was supplied to the recording device by an oscillator synchronized through a commutator . Time readings were accurate within .00002 of a second, the interval between stimulus and start of the potential response giving conduction time.

Over a dozen experiments showed a consistent diminution in conduction velocity following a period of about ten minutes tetanization. Rates were depressed to about 70% of normal at the end of the tetanus, rose rapidly and then more slowly, returning to normal values in about ten minutes. Both the magnitude of the initial decrease and the time required for full recovery are in good accord with the theoretical expectations.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 19.)

THE INTERNATIONAL CONGRESS OF EUGENICS

The Third International Congress of Eugenics will convene at the American Museum of Natural History on August 21, 22 and 23. It is therefore of interest to tell something of the history of the Congress as well as of its present organization and the plans for August.

The First International Congress of Eugenics, which was sponsored by the Eugenics Education Society of Great Britain, was held in London in 1912, under the presidency of Major Leonard Darwin. The Second Congress of this series met in New York in 1921, under the presidency of Henry Fairfield Osborn. The Third International Congress of Eugenics will be held in New York City in August, 1932, under the presidency of Charles B. Davenport, Director of the Department of Genetics of the Carnegie Institution of Washington and organizer of the Eugenics Record Office.

The first Congress in 1912 provided for a Permanent International Eugenics Committee which built up the International collaboration which made the second Congress possible. This Permanent International Eugenics Committee was changed, in 1921, to the Permanent International Eugenics Commission, which in 1925 developed into the present International Federation of Eugenic Organizations. This Federation, among other functions, fosters collaboration among the several nations in their eugenical researches, and sponsors International Congresses from time to time.

Dr. Davenport was formally selected president of the Third International Congress of Eugenics by the Ninth Meeting of the International Federation of Eugenic Organizations, which met at Farnham, England, in September, 1930. This same meeting of the Federation duly committed to the American delegation in the Federation the function of organizing and managing the Third Congress. In response to these two votes of the Federation, Dr. Davenport called the American delegation together at the Yale Club, November 18th, 1930. This delegation, by vote, formally accepted the responsibility and, in accordance with the actions already taken by the Federation, and the authority granted, perfected and announced the following working organization for the Congress:

President of the Congress—Charles B. Davenport, Cold Spring Harbor, Long Island, N. Y.

Honorary Presidents—Leonard Darwin, Henry Fairfield Osborn.

Vice Presidents—Victor Delfino, Argentina; H. Reichel, Austria; A. Govaerts, Belgium; D. F. Ramos y Delgado, Cuba; V. Ruzicka, Czechoslovakia; Sören Hansen, Denmark; A. Lüüs, Esthonia; Harry Federley, Finland; Georges Schreiber, France; Alfred Ploetz, Germany; Sir Bernard Mallet, Great Britain; Corrado Gini, Italy; Marianne Van Herwerden, Netherlands; Jon Alfred Mjöen, Norway; Leon Wernic, Poland; N. K. Koltzoff, Russia; H. B. Fantham, South Africa; H. Lundborg, Sweden; O. Schlaginhaufen, Switzerland; Irving Fisher, United States.

Treasurer of the Congress—Frederick Osborn, 52 Broadway, New York, N. Y.

Secretary of the Congress—Harry H. Laughlin, Cold Spring Harbor, Long Island, N. Y.

Chairman of Administrative Committee—Scientific Papers and General Program, Charles B. Davenport; Entertainment, Mrs. Charles Cary Rumsy; Finance, Frederick Osborn; Exhibits, Harry H. Laughlin; Publication and Publicity, Leon F. Whitney.

Managing Committee—Charles B. Davenport, Chairman; Irving Fisher, Vice-Chairman; Clarence G. Campbell, Madison Grant, Frederick Osborn, Leon F. Whitney, Harry H. Laughlin, Secretary.

It is the aim of the Congress, by means of papers, conferences and exhibits, to review briefly the history of eugenical work, and to present a survey of the present status of eugenics, both as a pure and as an applied science. If its work is well done it will serve to clarify the principles and aims of eugenics, and to point out the most profitable lines of eugenical endeavor for the next decade. The Congress will strive to mark a milepost in eugenical research and also to present to the public the real meaning and content of the science of eugenics and an appreciation of its importance in human affairs.

The Managing Committee of the Third Congress is anxious to establish early contacts with all persons in all countries who are interested in eugenical research and in race and family-stock betterment. It is hoped that this Congress will take full and critical stock of eugenical progress. In order to do this it must have wide and earnest support; it must be participated in by the outstanding students of human genetics, migration, mate selection, differential fertility and those forces which influence the turn-over of population quality from generation to generation. It invites friendly contact with, and participation in its work by, investigators in the contributing sciences—particularly anthropology, psychology, physiology, medicine and education. It welcomes collaboration also with those business houses and industries the prosperity of which depends most heavily upon specific human capacities.

An exhibition covering the history and present status of eugenical research will be held at the Museum in connection with this Congress. It is planned to open this exhibition on August 22d and to continue it, open to the public, until September 22d.

Immediately following the Third International Congress of Eugenics in New York City the Sixth International Congress of Genetics will be held in Ithaca, N .Y. (August 24-31, 1932), under the presidency of Thomas Hunt Morgan, director of the Kerckhoff Laboratory of Biological Sciences of the California Institute of Technology. Inquiries concerning the Genetics Congress should be addressed to Dr. C. C. Little, Secretary, Sixth International Congress of Genetics, Bar Harbor, Maine.

The Third International Congress of Eugenics, New York City, and the Sixth International Congress of Genetics, Ithaca, New York, are working in close collaboration. Papers on human genetics will be read at Ithaca, while all other phases of both pure and applied eugenics will be centered at the Eugenics Congress in New York.

The members of the two Congresses will be taken on an excursion to Cold Spring Harbor on Sunday, August 21st, to visit the Eugenics Record Office and the Station for Experimental Evolution, which, together, constitute the Department of Genetics of the Carnegie Institution of Washington.

It is planned to cover the history and proceedings of the Congress appropriately in a published report. This report will give in full the more important papers read before and submitted to the Congress, and will give an account of the proceedings of the Congress and a description of the exhibits.

The First Congress in London, 1912, published as its report "Problems in Eugenics"; Volume 1—486 pp.; Volume 2—186 pp.

The Second Congress in New York, 1921, published Volume 1—"Eugenics, Genetics and the Family"—439 pp. and 24 pls. Volume 2—"Eugenics in Race and State"—472 pp. and 20 pls. Exhibition book—64 pp. and 47 pls.

A similar policy is planned for the publications of the Third Congress.

The following classes of membership in the Congress have been established: Active membership, $5.00; Sustaining membership, $25.00; Supporting membership, $100.00; and patrons, those who contribute $500.00 or more. Both individuals and institutions are eligible to membership. Make all checks payable to the Third International Congress of Eugenics.

Each member will be entitled to all privileges of the meetings, exhibits and entertainments of the Congress, and will receive, without further charge, one set of the publications of the Congress.

The Managing Committee of the Congress will pass upon and either definitely accept or reject each application for membership.

Applications for membership and inquiries concerning the Third International Congress of Eugenics may be addressed to Harry H. Laughlin, Secretary, Cold Spring Harbor, Long Island, N. Y.

EVOLUTION AND "EVOLUTION"

A couple of weeks ago Mr. L. E. Katterfeld visited Woods Hole in order to create further interest in his magazine, "Evolution" and to obtain financial contributions towards its support. Dr. G. H. Parker introduced him to one of the seminar audiences at the Laboratory, and the following remarks of his were taken down in shorthand:

"I should like to say a word or two about Mr. Katterfeld and his magazine on evolution. The magazine has been published under very difficult circumstances. It comes out from time to time and is intended to inform school teachers and people in general what evolution means—it is educational in that way. I have seen a number of issues. I subscribe to them. The material seems to be put in such a fashion that would bring to school teachers and young people in schools, as well as people in general, some conception of what evolution is. For example, people who are not in biology are inclined to believe that the relation of monkeys and humans is the whole evolutionary proposal. In this magazine the variety of aspects and diversity of the material show how widely extensive the evolutionary concept is.

"Mr. Katterfeld travels around the country. He came to us at Cambridge. Some of us have subscribed and some have helped out with additional small sums—because teachers and professors are not able to do more—and it is these contributions, or what he calls subscriptions, that enable him to send copies to various schools. I have had him send copies to my friends. You can send copies as Christmas presents to your own friends. I have sent them to my enemies even and they have responded by getting some amount of information on this question. I believe this is a very worthy object. It is difficult to make any headway without extra help especially in these times of depression. It is a worthy and well worth while object and it does not matter how little the help is; if you can give, I beg you to do so."

Mr. Katterfeld then spoke for a few minutes and some of the things that he said are recorded here:

"First I want to express my appreciation to those who have made it generously possible for me to appear here, and to Dr. Parker for his kind remarks, and to show my appreciation I shall not take too much of your time.

"When I mentioned to somebody that I was coming to Woods Hole to talk about this magazine, they asked me if I had ever heard of the fellow who tried to sell coal to Newcastle.

"But, I am sure you can gather from what Dr. Parker has said that there is a little method in my madness. Of course I have not come here to tell you anything about evolution. In fact, I know very little about it. That is why I am a pretty good one to have charge of such a journal. If I can read an article and understand it, why any "dumbbell" can see through it.

"Our only fighting issue is that schools should be free to teach anything that Science finds out. We have one advantage, that is, not being the official organ of any scientific organization. We do not need to be quite so dignified. For instance, on the back page we carry a cartoon. There is nothing scientific about a cartoon. Some working man may see an article by Dr. Hegner, or Dr. Wells and nothing registers at all. But when he sees the cartoon he takes notice and grins. It helps prove to him that it isn't too highbrow for him, and he starts to read. We also poke a little fun at the fundamentalists. If the magazine was intended for scientists alone we wouldn't do that, but a great many people will start reading because of the fun we poke at them.

"Of course I think here in Woods Hole you have a larger percentage of evolutionists than in any other spot in the U. S. A. Fundamentalist influence even in New England is strong. For instance in Boston the high school Biology teachers are not permitted to deal with evolution at all. In many other schools to hold their jobs they must leave the matter alone. Some teachers get around the situation by taking up the subject matter but not the word Evolution.

"I hope you will find this little journal interesting and will help it to survive."

BOOK REVIEWS

Physiology of Bacteria, by OTTO RAHN, P. Blakiston's Son and Company. Philadelphia. xiv + 438 pp. 42 Figs. $6.00.

The physiology of bacteria and of other micro-organisms has generally received but scant consideration as compared with the attention given the physiology of the higher forms of life. The great abundance, universal occurrence, variety of activities, and numerous applications of these microscopic forms of life would justify more general interest than is in evidence at the present time. Since Duclaux's "Traité de Microbiologie," published in 1900, Lafar's "Handbuch der technischen Mykologie" (1905-1913), and Kruse's "Allgemeine Mikrobiologie" (1910), no large treatise appeared for a number of years, dealing exclusively with the physiology of micro-organisms. Within the last three years, however, there appeared several important volumes which tend to fill this gap. Here belong the encyclopedic "Physiology and Biochemistry of Bacteria" by Buchanan and Fulmer, the "Bacterial Metabolism," by M. Stephenson, and now the book under consideration, in addition to several other publications dealing with certain specific phases of the subject.

The author of this book states in the introduction that he made "an attempt to co-ordinate the various simplest functions of life, to study each function in itself and its effect upon the other functions." He is much justified in assuming that the principles developed in bacteriology reach out far beyond this field and can be applied to biology in general, and that "general physiology has much to learn from the physiology of bacteria." The general physiologist has neglected the lower forms of life which present excellent material for working out the laws of physiology, such as the principles of growth and reproduction, metabolism, influence of environment upon physiological processes, etc. The book is divided into four parts: A. Endogenous Catabolism. B. Energy Supply of the Cell. C. Growth. D. Mechanism of Death. This is followed by an appendix, dealing with the Size of micro-organisms, Multiplication of bacteria, and the Fermenting capacity of the cell, and by an author and subject index. The book is not intended to be a review of the subject as a whole, hence no attempt has been made to present a complete bibliography. However, the 20 pages of references are fairly representative of the literature.

Although filling a great need in a rapidly growing and important subject and although certain phases of the physiology of bacteria are treated in a most excellent manner, especially the problems involved in the growth and death of micro-organisms, the book is still not free from certain criticisms. The term *fermentation* has been much misused by the non-bacteriologist and unfortunately by many bacteriologists as well. As suggested originally by Pasteur, "fermentation is life without oxygen"; it represents a specific form of life. The author of this book, unfortunately applies this term without sufficient discrimination to all bacterial reactions, whether aerobic or anaerobic, whether involving the utilization of carbohydrates or of proteins as sources of energy. He speaks of the fermentation of proteins" (p. 56), as distinguished from "anaerobic putrefaction" (p. 59). It would tend to make our knowledge of bacterial processes much clearer, if the various terms, especially those of "fermentation" and "putrefaction" were used with greater discrimination since the specific "fermentation reactions," aside from their historical significance, had come to mean very definite processes brought about by anaerobic bacteria or by aerobic organisms living under anaerobic conditions.

The author has neglected to pay any attention whatsoever to a number of specific groups of bacteria, which possess a physiology very distinct from that of the common heterotrophic organisms. It is sufficient to mention, for example, the cellulose decomposing bacteria, some of which are unable to use any other source of energy but cellulose. The autotrophic bacteria, including those organisms which are able to synthesize organic matter out of inorganic substances (elements or their simple inorganic compounds) and of the CO_2 in the atmosphere, represent one of the most interesting chapters in bacterial physiology, due to the comparative simplicity of the reactions involved. However, the author disposes of all these organisms in a half a page, under the title "prototrophic fermentations," two words quite incorrectly applied.

These criticisms should not tend to detract, however, from the value of the book, which represents an excellent treatment of a chapter in bacterial physiology. —*Selman A. Waksman.*

The Glycosides. E. F. ARMSTRONG and K. F. ARMSTRONG, Longman's Green & Co., New York and London, 1931. $4.50.

This monograph deals with the chemistry and biological significance of those organic compounds which yield a sugar and some other carbon compound upon hydrolysis. Formerly such substances were termed glucosides but in recent years the generic name glycoside has been applied to them since sugars other than glucose frequently constitute their carbohydrate moiety. The text begins with a brief review of those aspects of carbohydrate chemistry which are pertinant to the topics which form the main body of the text.

This is followed by five chapters concerning the various classes of glycosides including the plant pigments and the so called cardiac glycosides. For the most part this portion of the text will be of more interest to the professional chemist than to the biologist. This is also true of the exceedingly brief chapter (5½ pages) on the uronic acids which could have been expanded without much effort on the part of the authors. The last two chapters concerning respectively the function of glycosides in plants and the utilization of carbohydrates in the plant contain much of general biological interest, although they suffer from a brevity which cannot be attributed to lack of available material concerning these topics.

The reviewer has noticed but two errors of statement. On page 51 the pharmacological activity of the cardiac glycosides is erroniously attributed to the presence of the unsaturated lactone group which is common to the structures of the glucones of these substances. Such is not the case, for as correctly stated on page 58 Jacobs and Hoffman have shown that hydrogenation of the unsaturated linkage of the cardiac glycosides markedly decreases their pharmacological activity but does not completely abolish it. Incidentally it is amusing to note that although the authors stress the desirability of using the term glycoside in place of the older terminology they speak of the cardiac "glucosides" on page 57 although the majority of these important substances contain sugars other than glucose as shown in the tables on pages 52 and 56.

In discussing the nucleosides (page 73) it is stated that the component nucleosides of animal nucleic acid may be obtained in the same way as those from plant nucleic acid, namely by neutral hydrolysis under pressure. This is far from the truth, for the former are obtainable by enzymatic hydrolysis only, a fact which in the past has contributed much to the difficulties encountered in the determination of the structure of the desoxyribose nucleosides found in animal tissues.

Aside from the misstatements just referred to, the text is remarkably free from errors of fact. In some instances, confusing statements occur. Thus on page 55 we read, "The glycosides of the seeds are not reserve materials but disappear during germination and are stored in the leaves, in which organs they do not increase further in quantity." And in the next sentence, "The leaf glycosides are found in the earliest foliage leaves and continue to increase in quantity until they form 1 per cent. of the dried matter; it is supposed that they are only waste products of the metabolism of growth." Further confusion arises when one compares the last of this sentence with the conclusion reached on page 98 where it is stated, "The most important function of glycosides would appear to be their action in keeping dormant and unchanged substances of great importance in the metabolism of the plant until the precise moment when they are required." Of course, some of this confusion is due to the unsatisfactory state of our knowledge concerning the rôle of the glycosides in the biochemistry of the plant, but the uncritical manner of presentation adopted by the authors is apt to obscure experimentally established facts. This perhaps is due to the fact that the authors are primarily concerned with the chemistry of the glycosides.

In some instances, certain of the topics mentioned might have been elaborated upon with profit. Thus, on pages 48 and 49 the interesting theory of Mrs. Wheldale-Onslow concerning the inheritance of anthocyanin colors and their relationship to genetic factors is dismissed in four sentences. Similarly the discussion of Robinson's ingenious theory of the origin of anthoxanthins and anthocyanins is too concise to be of much utility to the uninitiated. On the other hand, these shortcomings are compensated for by the inclusion of an excellent bibliography.

This book is one of the Monographs on Biochemistry and, as with the other volumes in this series, the publishers have maintained their high standard both in workmanship and price.

—*Kenneth C. Blanchard.*

THE BEACH QUESTION AND THE LOT HOLDERS

Because of the active interest of everyone in Woods Hole in the discussion of "the beach question," we take space from this number to quote from *The Falmouth Enterprise* of July 28:

"A sub-committee of the general committee which is studying the adequateness of bathing beach facilities at Woods Hole met last night and heard seven or eight people who maintain that Woods Hole needs more beach privileges and made suggestions as to how to work for them. The committee will report Saturday to its general committee. It was announced that a public meeting will be held later.

"Among Woods Hole property owners adjacent to the Bay Shore beach are the estates of the late Hector J. Hughes, Dr. Oliver Strong, Dr. Otto Glaser, Dr. Manton B. Copeland, Dr. Addison, Dr. E. N. Harvey, Dr. R. Chambers, Dr. Frank R. Lillie, Mrs. E. G. Gardiner, Edward A. Norman. Many of them have appeared in conference before the sub-committee of the Beach committee, and members of the group prepared the following statement for the *Enterprise*:

"Recently 'The Collecting Net, a weekly devoted to scientific work' distributed a broadside in Falmouth which had very little mention of scientific work in it, but was largely devoted to the discussion of the beach situation in Woods Hole.

" 'The Collecting Net states that the beach lots on Bay Shore had "been reserved for the use of five investigators." We find this to be incorrect. The Fay Estate never reserved these lots, but put them in the open market. They were then bought by the present owners.

" 'The statement that 'Falmouth owes Woods Hole a beach' is misleading to those not familiar with the situation, and puts our selectmen in a wrong light, as it suggests that at present there is none. As a matter of fact Woods Hole has six beaches serving various groups of tax payers.

" '1. Nobska Beach, a very fine one, is used by all the residents of the Nobska Point region and some of the Laboratory workers.

" '2. Juniper Point Beach, owned by Mr. Crane serves a group of bathers there.

" '3. Penzance Point Beaches, of which there are two, plus many private bathing piers take care of all the residents on the point.

" '4. Gansett Beach, is especially set aside for all the owners of property on that part of Crow Hill known as Gansett and numbering 29 cottages.

" '5. A beach on Quissett Harbor used by the cottagers on the private road.

" '6. The Bay Shore Beach, open to any resident of Woods Hole as stated in the deed.

" 'As well as these beaches over twenty-five residents on Vineyard Sound and Buzzards Bay shores have their own bathing facilities and do not need to use the other beaches.

" 'It is the Bay Shore Beach to which the editorials in The Collecting Net refer. The problem here is really not one of bathing at all, as this is excellent, but entirely a matter of more sand space for sunners. As the number of people using the beach scarcely reaches 50 at even the most popular hours, and is below 80 on Saturdays, it can be seen that a relatively small number of tax dollars is involved.' "

"A movement is on foot in Woods Hole which may result in action looking towards taking a beach for public use by eminent domain.

"Originally broached last summer by Dr. Caswell Grave and Ware Cattell, editor of The Collecting Net, on July 11 a committee of 20 met to discuss beach facilities at present available in Woods Hole.

"The committee which is considering Woods Hole beach facilities is composed of Dr. R. P. Bigelow, Dr. R. A. Budington, Dr. Robert Chambers, Dr. E. R. Clark, Dr. Manton Copeland, Mr. Robert Goffin, Dr. H. B. Goodrich, Dr. Benjamin Grave, Dr. Caswell Grave, Dr. L. V. Heilbrunn, Mr. Thomas Larkin, Mr. E. M. Lewis, Dr. Edwin Linton, Mr. James McInnis, Dr. Charles R. Packard, Dr. Fernandus Payne, Dr. A. C. Redfield, Dr. C. R. Stockard, Dr. O. S. Strong, Captain John J. Veeder.

"A sub-committee was appointed consisting of Dr. E. R. Clark, Dr. H. B. Goodrich, George A. Griffin, Thomas E. Larkin, Dr. C. R. Stockard.

"Projects suggested for the committee's consideration:

"(1) Purchase of the beach rights of Lot X (Miss Fay's Deed of Trust) and Dr. Oliver Strong's lot, containing the bathhouse.

"(2) Purchase of the beach rights of four lots belonging to Dr. S. C. Brooks, Dr. Otto Glaser, Dr. W. H. F. Addison, and Dr. E. N. Harvey.

"(3) Purchase of the beach rights of the Brooks, Glaser and Addison lots and expenditure of $1,000 to improve the beach.

"The present public bathing facilities at Woods Hole were provided by Deed of Trust of Miss Sarah B. Fay, accepted by the town at annual town meeting in February 1928. All "inhabitants of that part of Falmouth known as Woods Hole as make it their home" already are guaranteed in perplexity bathing privileges, with right to use 15 lockers in the existing bathhouse and right of way to the beach.

"Miss Fay, carrying out the wishes of her late father, Joseph Story Fay, and late brother, Henry H. Fay, original owners of the property, set aside "Lot X", forty feet wide to provide bathing opportunities for all inhabitants of Woods Hole on the Bay Shore.

"The acceptance of Miss Fay's benefaction, was moved and championed at the 1928 town meeting by two Woods Hole men now serving on the "Beach Committee," Thomas E. Larkin and George A. Griffin.

"Shortly after Miss Fay executed this Deed of Trust, the property was placed on the market and sold, subject to this restriction, to Dr. E. B. Meigs who is now trustee under the deed.

"The town has no expense in connection with this beach to Woods Hole inhabitants and the bathhouse is maintained by the trustees."

Editorial Note: We must reserve detailed comment until the next number, for this issue was getting ready for the press when the Falmouth paper came to us. However, we can not refrain from calling especial attention to the statement above that the residents of Woods Hole "already are guaranteed in *perplexity* bathing privileges" on Lot X. How peculiarly appropriate the word "perplexity" is!

The Collecting Net

A weekly publication devoted to the scientific work at Woods Hole.

WOODS HOLE, MASS.

Ware Cattell .... Editor

Assistant Editors

Florence L. Spooner Annaleida S. Cattell
Vera Warbasse

Contributing Editor to Woods Hole Log
T. C. Wyman

The Beach Question
V

The sub-committee which is giving consideration to the question of enlarging the bathing beach facilities in Woods Hole met again on Wednesday. They invited certain representative individuals—selected from members of the laboratory and residents of the town who object to the action of the lot-holders on the Bay Shore in erecting the fence—to express their opinions. The sub-committee plans to meet again today to draw up a final report which we understand will be presented at a public meeting to be scheduled about the tenth of August.

Everyone in Woods Hole is under obligations to the sub-committee, which is unselfishly devoting a great deal of time and energy in an effort to make a sagacious decision. The problem is a fundamental one to the community as well as to every member of the laboratory. Woods Hole should have obtained a beach twenty years ago. It is difficult to do so now, but twenty years later it will be still more difficult. Immediate needs are important, but they are transitory. Any plans made now must be sufficiently comprehensive to safeguard a growing town. The last two years have seen two developments which indicate that Woods Hole has a future; one is the choice of Woods Hole for the Oceanographic Institution, the scope of which is not local but national; the other is the addition of air transportation to this district. Besides the sea plane service between the islands, Woods Hole and New Bedford, there has now been established a "commuters service" between Falmouth and Boston.

Woods Hole should plan a beach now, not only for the present, but one which will be sufficient to comfortably care for its increased population in years to come.

We believe that the lot-holders on the Bay Shore beach ought to be sufficiently cooperative to remove the fence that was erected last summer. If they do not, we firmly believe that it will be in the interests of the Woods Hole community to have Falmouth take over the beach by its right of eminent domain—and THE COLLECTING NET will work energetically toward that end.

Ourselves

We have been critisized for being too dry, we have been lectured for being too frivolous. We have been told that it is impossible to be a hybrid between a biological monograph and a newspaper—and that if we want to survive in this day of specialization our contents must be homogenous. We maintain that we would have little reason for existing at all if we were not different from every other publication. *The Biological Bulletin* and *The Falmouth Enterprise* are admirable publications of their kind, but we do not want to mimic either one!

Workers at the laboratory are interested in their environment, as well as in their work, and we propose to cover fairly completely the news concerning it. To become monographical would be suicidal. A biologist of distinction once remarked that THE COLLECTING NET was the only scientific magazine which was read in the summer time!

Of course, our first wish is to accurately and thoroughly report the work carried out in the three scientific institutions in Woods Hole, and news concerning them and their workers. We might be called an unofficial organ of these institutions. In general, material of no scientific interest will be segregated at the end of the magazine in a similar way that the Science Service material is handled in *Science*—or the comic section in the Sunday newspaper.

We shall be delighted to receive expressions of opinion from our readers. Naturally we want to adopt a policy which will be endorsed by a definite majority of the scientific workers in Woods Hole.

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
July 30	2:42	2:48
July 31	3:27	3:33
Aug. 1	4:12	4:18
Aug. 2	4:54	5:03
Aug. 3	5:37	5:50
Aug. 4	6:20	6:35
Aug. 5	7:04	7:23
Aug. 6	7:50	8:13
Aug. 7	8:37	9:07

In each case the current changes approximately six hours later and runs from the Sound to the Bay. It must be remembered that the schedule printed above is dependent upon the wind.

ITEMS OF INTEREST

The Annual Meeting of the Trustees of the Corporation of the Marine Biological Laboratory will be held at 11:30 A. M. on August 9. New members will be elected by the trustees. Application blanks for membership in the Corporation may be obtained at the Administration office and must be given to Dr. Charles Packard, Clerk of the Corporation, on or before August 5.

Dr. Edmund B. Wilson, Da Costa professor of zoology at Columbia University, has been elected a corresponding member of the Vienna Academy of Sciences.

Dr. L. A. Brown has resigned his position as associate professor of zoology at George Washington University and is available for an appointment in zoology or physiology.

Dr. George P. Berry, formerly of the Rockefeller Institute for Medical Research, has been appointed professor of bacteriology and head of the department, in the School of Medicine, University of Rochester and at the same time will act as associate professor of medicine.

A week or two before his death, Graham Lusk, was elected to foreign membership by the Royal Society of London.

Dr. Frank Pell Underhill, professor of pharmacology and toxicology for eleven years at the Yale University School of Medicine died on June 29. Dr. Underhill had been associated with Yale University for thirty-two years.

Dr. Herman Von W. Schulte, dean of the Creighton University Medical College since 1917, died on July 13. Dr. Schulte was at one time associate professor of anatomy at Columbia University.

A card from Dr. H. Herbert Johnson, instructor in biology at the College of the City of New York, announces the birth of a daughter on July 24, in Brunswick, Georgia.

The zoological field station of the University of kentucky at Quicksand, Kentucky has been discontinued.

The Fifth International Congress of Entomology which convened in Paris, adjourned on July 24.

SCRIPPS INSTITUTION OF OCEANOGRAPHY
(Received July 23)

On Tuesday of this week Captain C. B. Mayo, Commanding Officer of *U. S. S. Ramapo* visited the institution, spending most of the day discussing with members of the scientific staff of the Institution the preparation of a relief map of the bottom of the North Pacific. In the last few years the *Ramapo* has done more work on the submarine configuration of the North Pacific than all other agencies of the world together.

Other visitors on Tuesday of this week were Prof. W. P. Kelley of the Citrus Experiment Station at Riverside, Mr. Gordon Surr of the same station, and Prof. A. O. Woodford of Pomona College. Their visit was for the purpose of discussing with Director T. Wayland Vaughan and other members of the scientific staff the geological problems connected with Professor Kelley's studies of base exchange in soils.

On Monday of this week Mr. D. W. Gravell arrived at the Institution to spend a week in special study on foraminifera. Mr. Gravell was formerly a graduate student at the Institution.

MT. DESERT ISLAND BIOLOGICAL LABORATORY
(Received July 23)

With the change in administration of the Laboratory many innovations have come. The small laboratory building known as "the survey shed" has been entirely renovated and rather complete facilities for biochemical investigation have been installed. Dr. Marshall and Dr. Smith and five assistants are now at work in this building. The library has been reorganized and the Naples system of "shingles" to mark the place of borrowed books, has been installed. The popular lecture course has been given up and a course of scientific lectures has been substituted by the Dorr Station. These lectures are to be run by subscription, $5.00 a season ticket, and they are to be held Tuesday afternoons in the Jordan Pond House. Among other things, we have a new still for distilling water, a new stove and a General Electric refrigerator in the Dining Hall kitchen.

The annual Laboratory picnic was held early in July at the Dining Hall, an evening picnic instead of the customary Fourth of July noon beach party. After a supper of steamed clams and lobster salad, a program of dancing and bridge followed in the new wing of the Dining Hall. A rainy night outside could not dampen the spirits of the members of the Laboratory.

WOODS HOLE LOG

THE WORK OF THE COAST GUARD

The following letter from Mr. Hillard M. Nagle, recently addressed to the Coast Guard Station at Woods Hole, gives some indication of the different kinds of work they are called upon to do, and which must be interesting to them, if only for the sake of breaking the monotony of rescuing unfortunate boats and individuals.

"We are making a survey of bird life during the coming migratory period in cooperation with the Biological Survey of the U. S. Department of Agriculture. The survey is to be conducted in the general vicinity of Gooseberry Island and the waters of Hen and Chicken lightship and Cuttyhunk.

We would like to know if you would detail a boat to assist us in carrying out this work which is preparatory to later bird-banding operations.

A party of ten would be ready to leave the town wharf at Westport Point on the East branch of the Westport River, one mile from the entrance to Westport Harbor, on Friday, July 15, at 10:00 A. M.

As our party is small and the territory we are to cover is considerable, we would suggest that you send a speed boat in order to cover the above locations."

In connection with the above letter, the Coast Guard dispatched a patrol boat which took the party on its all-day expedition. It expects to take another party doing the same kind of work, over to Muskeget Island, Nantucket, on July 27.

The Coast Guard Station at Woods Hole has been kept unusually busy during the past week, there being no less than five assistance reports on record, and all involving a certain amount of hard work!

While patrolling in the vicinity of Pollock Rip Slue, on July 19, a coast guard boat sighted a vessel flying distress signals. Upon investigation, it was found to be the *Fannie S* of Boston, whose wheel was completely enmeshed in a large fishing net. The boat was towed to Nantucket, and beached there.

While on New Bedford patrol area, on the morning of July 20, a coast guard boat received orders from headquarters to proceed northeast of Gay Head to investigate a fishing boat reported in distress. It was found to be the fishing sloop, *Pal* of Point Judith, Rhode Island, which had a disabled motor. It was towed to New Bedford.

On July 22, a Coast Guard boat, patrolling off Great Point Light, Nantucket, received a message ordering it to proceed to Shovelfull Shoals to assist a fishing schooner aground there. The patrol boat waited until high tide and then ran a line to the schooner by means of a Monomoy surf boat. The vessel was floated, but grounded again three times before it was finally cleared of the shoals.

On the afternoon of July 24 orders were received from the "Officer-of-the-day" to proceed with a patrol boat to the assistance of a two-masted gas-screw yacht aground on Great Ledge, Woods Hole. A towing line was made fast to the yacht and the latter was easily pulled off the ledge. The yacht proceeded to the steamboat wharf under its own power.

On the morning of July 26, a call was received from the *S. S. Van Buren*, saying that a yacht had sighted adrift four miles east of Pollock Rip lightship. A patrol boat was ordered out to get her in tow. The yacht was owned by Charles Pipenbrink of Boston, and had a disabled motor. It was towed to Provincetown, and about half way up the coast guard boat was relieved by another patrol boat, the *Dix*, which completed the journey. —*F. L. S.*

THE M. B. L. CLUB

Under the active leadership of Dr. Heilbrunn (and Mrs. Heilbrunn) the M. B. L. Club is suddenly beginning to bustle with activity—externally as well as internally. Perhaps one of the most interesting innovations will be a four-piece orchestra which will play at the Clubhouse every Saturday night beginning on August 6. The dance will be free to members of the Club, but there will be an entrance fee of 50c for each individual who does not belong to the Club.

The Sunday singing will be revived, and plans are also under way for the establishment of a lending library. Good books of various kinds will be available for a modest sum.

Everyone who is eligible for membership should join, because only members will be permitted to enjoy the benefits of the Club.

The exhibit of the work done by the children this summer in the Children's school of Science will be held at the School House on Friday, August 5th at 2:00 P. M. Visitors are welcome and are sure to be interested in seeing what scientific ability the younger generation of this community have. —*V. W.*

The fire siren has been blowing quite a bit recently, but none of the fires, fortunately, have been in Woods Hole. Sunday morning there was a fire in a garage in West Falmouth. On Monday there were two fires, one a brush fire at Silver Beach, and the other caused by an oil burner on Walker Street in Falmouth. —*V. W.*

(Other pages of the Woods Hole Log will be found on pages 158 and 160)

WOODS HOLE LOG

WOODS HOLE YACHT CLUB

The results of the races on Monday are as follows:

Buzzards Bay Class

1. *Grand Turk* .... Geoffrey Whitney
2. *Scampi* .... Louise Crane
3. *Mink* .... Gaspar Bacon, Jr.
4. *Cletheris* .... Eliot Forbes
5. *Knight* .... David Emmerson

Cape Cod Knockabouts

1. *Tyro* .... Mrs. Crossby (sailed by F. Copeland)
2. *Nika* .... Dr. Kenneth Cole
3. *Porpoise* .... C. M. Glaser
4. *Windward* .... Morris Frost
5. *Menidia* .... Dr. R. P. Bigelow

Dories

1. *Aunt Addie* .... Wistar Meigs
2. *Dorine* .... Alan Clowes
3. *Sea Robin* .... Albert Woodcock
4. *Lobster* .... Mrs. Barbara Prosser Gifford

Catboats

1. *Lurline* .... Alfred Compton
2. *Dinny* .... V. Warbasse

The Woods Hole Yacht Club has been invited to partake in the Edgartown Regatta this week-end, and any member of the yacht club was asked to take his boat and race it. They were also invited to dinner and dance Friday night. About ten boats planned to leave our harbor on Friday afternoon. —*V. W.*

With the beach question so much in people's minds, it was recently suggested that the Hughes house which is opposite the I. O. Woodruff's house, and next to the Murray Crane's, be bought and turned into a beach and Yacht Clubhouse. At Nantucket and Edgartown such a club has been very successful. The beach adjoining it, facing the bay, is of fine quality sand, and a wharf could be easily built into the harbor. The cost of making these improvements would be about $50,000. If fifty families in Woods Hole could contribute $1,000 each, this project could be put over. Many people have shown interest in this, and it is hoped that we may be able to have such a beach and Yacht Club sometime. —*V. W.*

Miss Elizabeth Fenner who has been leading actress in the Theatre Unit Incorporated for four years, was married last Saturday to Mr. Thomas B. Gresham, Jr., from Baltimore. —*V. W.*

PROTOZOOLOGY PICNIC

I was fortunate enough to be invited to the Protozoology picnic, held on July 26 at Tarpaulin Cove. Before the party was rowed ashore, we had a ride on the *Cayadetta* down to Gay Head. After everyone had partaken fully of the very plentiful food, the memberes of the staff who were guests of the class were called on for speeches. A track meet of several events in which all were urged to compete, was conducted. The day ended with a tug-of-war in which all the men participated, and an exciting baseball game for everyone. No one could have had more fun. —*L. M.*

While operating a couple of freight trailers, Mr. Ted Wyman met with an accident early this week. The coupling pin between the two trailers fell out, suddenly, causing the two to come together, and Mr. Wyman's foot got caught between the two. While no bones were broken, his foot was so badly jammed that it was badly torn and it was necessary for three stitches to be taken. Mr. Wyman is about on crutches now, and is expected to be able to use his foot in about two weeks. —*F. L. S.*

As the 6:20 P. M. boat for Nantucket was docking last Saturday, the passengers and other spectators on the wharf were treated to a spectacle that would have tickled the fancy of even a Joseph Conrad. Two fishing boats were tied up on the north side of the steamboat dock, and aboard one of them, the *Klondike,* a battle royal was taking place. One of the seamen, a red-headed Viking with a soft southern drawl, was feeling the effects of a stimulant known as moonshine. Apparently he had persuaded himself that in the interests of science, or for some other reason known only to himself, it was his duty to disect his fellow seamen with a delicate fish knife some two feet and a few odd inches in length. Someone had evidently notified the local policeman, who immediately boarded the boat. The policeman did not appear to be interested in the fine points of the operation that was about to take place, and finally put an end to the fracas by taking the two seamen with him for a joy ride to Barnstable. —*T. C. W.*

Some of the boys acting as porters on the wharf in Woods Hole manage to pick up three or four dollars a day. —*V. W.*

(Other pages of the Woods Hole Log will be found on pages 156 and 160)

WOODS HOLE LOG

AT SILVER BEACH

The Theatre Unit this past week produced Elsie Schaufler's "Peep Show" under the supervision of Arthur Beckhard. The plot itself was excellent, but the play needs a lot of re-writing. I think that the company should have chosen a play which was more of a change from Berkely Square. During both plays the characteers were taken back a number of years. In this play a young couple fear they can't marry because the girl lives in terror ot her tyrant Aunt. By means of a fainting spell, she is carried back five years and you later discover what caused the trouble, and the plot is gradually cleared up.

Sir John, the guardian, played by Myron McCormack, is badly cast. He was too young and too short of stature to be convincing. The hero, Bretaigne Windust, was passable, but he seeemed stiff. The tyrant Aunt, played by Mildred Natwick, was done very well. The heroine, Katherine Squire, was excellent in every way. She was convincing and perfectly at home in her part. Mr. Beckhard, previously associated with her at Greenwich and at Woodstock, correctly saw in Miss Squire the ideal Penelope. *—V. W.*

The Annual Meeting of the Association of the Children's School of Science will be held in the School House Tuesday, August 20, at 2:30 P. M. *—V. W.*

The Annual Meeting of the Woods Hole Protective Association will take place on Thursday, August 11 at 8:00 P. M. in the Old Lecture Hall.

Dr. C. D. Darlington of The John Innes Horticultural Institute, spoke at the Penzance Forum last Sunday on "The Political Situation in England." He explained that England was not recovering from the depression any more than the United States. He compared the two countries very ably and clearly. Dr. Darlington showed that, although he is widely known for his scientific work, that also he is a keen observer of the present economic situation. *—V. W.*

It seems that there are an unusual number of food sales going on in Woods Hole. Last Saturday on the Crowell's lawn opposite the Post Office there was such a sale sponsored by the Ways and Means Committee of the Woods Hole Woman's Club. On Friday afternoon there was one on the corner of North and West Streets for the benefit of St. Joseph's Church. *—V. W.*

A newcomer to Woods Hole heard someone call the Bradley's house on Juniper Point the airplane house. She immediately inquired if that was the place they kept all the planes that flew around here. *—V. W.*

Mr. Gifford Griffin, who rescued Dr. Alfred Meyer when he fell overboard at the airplane dock, very successfully imitated him the other day. While pulling the airplane into the dock he missed his footing and became completely soaked. *—V. W.*

(Other pages of the Woods Hole Log will be found on pages 156 and 158)

THE COLLECTING NET

Vol. VII. No. 7 SATURDAY, AUGUST 6, 1932 Annual Subscription, $2.00
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THE PENIKESE SCHOOL FIFTY-EIGHT YEARS AGO

On Tuesday we received the following note from Mrs. Helen H. Neal, Salisbury Cove, Maine: "The enclosed will explain itself. Would you care to use it—or parts of it—in THE COLLECTING NET. We hope you may!" One of the enclosures was a letter to Mrs. Neal from Mrs. William R. Belknap of Louisville, Kentucky, dated October 12, 1931:

"During my visit to you I happened to speak to Doctor Neal about my Aunt who, many years ago, was a student at Penikese. I wrote her of his interest and asked if she would write an account of her experience. The enclosed correspondence with my Aunt and the notes she supplied on the subject are self-explanatory. When I received her account I told my brother-in-law that I intended going over it with the purpose of blue pencilling the repetitions which, as you will see by her letter she anticipated as possibilities. Mr. Davenport said he thought it much better to send the statement exactly as it came from her pen. I am accordingly doing (*Continued on page* 167)

M. B. L. Calendar

TUESDAY, AUGUST 9, 8:00 P. M.

Seminar: Mr. D. P. Costello: "Surface Precipitation Reaction in Marine Eggs."

Dr. P. S. Henshaw: "Changes in Sensitivity of Drosophila Eggs during Early Development to Hard and Soft X-rays, Gamma Rays and Alpha Particles."

Dr. Ralph M. Buchsbaum: "Size of Explant and Volume of Medium in Tissue Cultures."

Dr. B. H. Willier: "Germ Cells in Relation to the Origin and Differentiation of the Sex Gland of the Chick as Studied by Chorio-allantoic Grafts."

FRIDAY, AUGUST 12, 8:00 P. M.

Lecture: Dr. Alexander Forbes: "Surveying in Northern Labrador." Illustrated.

THE GROWTH AND REPAIR OF LIVING NERVES

DR. C. C. SPEIDEL
Professor of Anatomy, University of Virginia.

For the past three years I have been studying living nerves in frog tadpoles both under normal and experimental conditions. Individual nerve fibers are kept under observation for prolonged periods. This evening I should like to give a brief resumé of some of my earlier observations and a more detailed account of my later studies.

Several phases of nerve activity may be considered: (1) the activity of the growth cones of single nerve fibers; (2) the movements of sheath cells correlated with the origin and growth of the myelin sheath, and varieties of adjustment and readjustment; (3) the phenomena associated with nerve irritation and recovery, degeneration and repair.

Growth cones were first recognized by Cajal in fixed tissues long ago and were called by him "cones d'accroissement". Harrison was the first to study these in living nerve cells cultivated *in vitro*. They may be seen and studied to

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best advantage in the living animal in the rapidly regenerating tail fin.

My observations of these growing tips of nerve fibers in frog tadpoles amply confirm the principle of stereotropism or tactile adhesion, noted by Harrison. These tips often follow in a general way the processes of fibroblasts. The later growth cones tend to follow the earlier ones, small nerves being formed in this manner. Occasionally growth cones move along the same pathway in diametrically opposite directions, a fact which is of importance for various theories of neurogenesis. Many temporary and permanent anastomoses are established by the growth cones in their progress toward the skin. Mitosis, both of fibroblasts and of sheath cells, appears to have a direct stimulating effect upon nerve sprouts. The sprouts are directed and oriented to some extent by the definite alignment of the fibroblasts and by the movements of the tissue juices resulting from movements of fibroblast processes. A "hydrodynamic factor" may thus be considered of some importance in the orientation of nerve sprouts.

Growth of the sprouts is not necessarily continuous, but is often sporadic in nature. The growth cones are usually characterized by a few highly refractive vital granules which appear and disappear continually.

Growth cones are not unique for nerve tissues. They are found also in association with endothelial cells in growing blood and lymph capillary sprouts, in fibroblasts, and probably in other cells, particularly those with long processes.

The myelin sheath appears somewhat later after early unmyelinated nerves have become well established. Sheath cells migrate out from the spinal cord, proliferate by mitosis and are present on the early unmyelinated nerves before the myelin sheath is formed. Young sprouts which are to become myelinated follow, in a general way, the earlier unmyelinated nerves.

Sheath cells transfer to them, the direction of transfer being almost always from "non-myelin-emergent fiber" to "myelin-emergent sprout." Myelin-emergent sprouts exhibit a pronounced bias toward myelin formation, the combination of myelin-emergent fiber and sheath cell leading, within a few days, to the production of the myelin sheath. On the other hand, non-myelin-emergent fiber combined with sheath cell does not ordinarily result in the formation of myelin. The differential factor, therefore, which determines the formation of myelin is not in the sheath cell, but is in the nerve fiber.

The myelin is laid down in segments, one segment genetically corresponding to the zone of influence of one sheath cell. The earliest myelin usually appears near the sheath cell nucleus, an indication that the nucleus may be of special importance in the process. My records include complete case histories of the formation of more than 100 myelin segments.

Myelin segments, though relatively stable may undergo various changes. Thus, end-to-end-anastomosis of two segments may occur; rarely, the sheath cell of a segment may divide by mitosis and the two new segments result; a portion of a segment may be appropriated by the next segment and a new node of Ranvier established. At sharp bends in a fiber a bare length may be left between two myelin segments; these later acquire myelin segments by the process of intercalation.

The cause of myelination is unknown. A theory, supported by some, states that the assumption of function by a nerve fiber causes it to become myelinated. My observations, however, show that many myelinated fibers have not reached their end organs. Since the growing tips of these are still progressing through the tissues it seems certain that they have not yet assumed their typical functions. The theory, therefore, that assumption of function leads to myelination cannot be rigidly maintained.

During the process of myelination autotomy of side sprouts may take place with or without the involvement of myelin segments. Loss of side sprouts by process of retraction is also common.

Myelin probably belongs, not to the sheath cell, but to the axis cylinder. A leucocyte invading a normal myelin segment travels not between the axis cylinder and myelin sheath, but between myelin sheath and neurilemma sheath. A similar conclusion has been reached by de Renyi from microdissection work.

My observations combined with those of del Rio Hortega strongly suggest the mechanism of myelination in the brain and spinal cord. Hortega points out that the oligodendroglia cell of the central nervous system corresponds to the sheath cell of the peripheral nerves. The fixed preparations of Linell and Tom indicate that these cells are associated with myelin formation in young rats just before birth. It seems probable that myelin formation is essentially similar in central nervous system and peripheral nerves, and that the oligodendroglia cell is the myelinating cell of the brain and spinal cord.

Although nerve cells and sheath cells may both be readily cultivated by the tissue method, no one has yet been successful in obtaining myelin sheath formation *in vitro*.

Nerve regeneration has been studied following operations on small nerves or single fibers. Harrison long ago noted that unmyelinated nerves in the tadpole when cut seemed to rejoin and heal by first intention, the distal stump not undergoing total degeneration. Williams recently re-investigated this point and found no healing by first intention, but held that the growth cones from the proximal stump are sufficient to explain the apparent reunion of the stumps. My own work suggests that the distal stump behaves differently depending upon whether or not there exist peripheral anastomoses. Complete degeneration occurs if these are lacking. Partial degeneration occurs if these are present. A few retrogressive fibers are probably present in the distal stump which have not, therefore, been separated from their nerve cells, being connected to them by way of an anastomosis. Thus the union of the proximal and distal stump is in reality a union of two proximal stumps. Reunion of proximal stumps is of common occurrence after nerve section.

Sheath cells which may be isolated in the tissues following nerve section, either of myelinated or unmyelinated fibers, show a marked affinity for nearby nerve fibers. They often return to the nervous system by amoeboid movement when experimentally isolated. Many varieties of chemotactic response on the part of the sheath cells have been recorded. These cells without question play a prominent rôle in the restorative processes.

Several case histories demonstrate that myelin segment degeneration may occur coincidentally with vigorous growth of the nerve fiber enclosed. Thus myelin degeneration may be independent of axis cylinder degeneration.

The *early* changes associated with nerve irritation, traumatic degeneration and trophic degeneration have not been adequately observed and recorded in the literature. In his exhaustive treatise Cajal vaguely states that there are some early slight changes, but just what these are is not specified. My observations indicate that profound disturbances immediately take place following injury. A myelin segment shows a pronounced fluid reaction with swelling and vacuole formation; the myelin sheath exhibits a typical rippling and twisting activity; the axis cylinder assumes an irregular, wavy course; and its neurofibrilar structure becomes visible. The sheath cell nucleus becomes glassy as though its contents were becoming liquefied, and it becomes less intimately applied to the myelin sheath. The vacuoles later disappear and the entire axone straightens, though it remains somewhat swollen for some time.

A segment appears to straighten by a "turgor reaction." If the irritation is not too great, the fiber may become normal again, the neurofibrilar structure becoming invisible. If, however, the fiber has been cut, or the irritation from another source is quite marked, typical degeneration follows with the myelin breaking up into ellipsoids and later into granules.

Donaldson has pointed out that water absorption and myelination are correlated. My observations on irritated myelinated fibers indicate the relatively fluid condition of the axis cylinder.

Parker's interesting concept of neurfibrils as functioning in the transport of tropic or toxic materials may also be referred to here. In irritated fibers pronounced fluid movements may readily be distinguished in the axis cylinder. This observation lends some support, perhaps, to such a conception.

It may also be pointed out that a fluid reaction in irritated nerves is essentially similar to the fluid reaction or swelling exhibited by injured tissues in general. Unmyelinated fibers, whether irritated or cut, show early changes fundamentally similar to those of myelinated fibers.

Many case histories have also been obtained of repair of mixed nerves, small and large, and of new and collateral regeneration.

Among the nerve activities which I have recorded by the motion picture method are the following: the progress of the first, second and later growth cones of single nerve fibers; anastomosis formation; retraction; movements of fibroblasts and their effect on growth cones; movements of sheath cells; mitoses of sheath cells; addition of new myelin segments at the end of a fiber; formation of a myelin segment at a node of Ranvier side-sprout; the actual, though slight, extension of the myelin sheath over a period of two hours; invasion of regenerating and normal nerves by leucocytes; deformation of nerve fibers by tension of connective tissue cell processes; stimulation of nerve sprout formation by fibroblast mitosis; traumatic irritation of a proximal stump myelin segment and its recovery; the earliest changes associated with trophic (Wallerian) degeneration; irritation and recovery of a myelin segment following a nearby non-nervous wound.

(This article is based on a lecture presented at the Marine Biological Laboratory on July 29.)

THE PENIKESE SCHOOL FIFTY-EIGHT YEARS AGO

(Continued from Page 165)

so, with this explanation. In a letter since then she has said 'When Miss Ruth Dailey read to me her typed copy of my Penikese notes I discovered that I had told her the same story twice in more than one instance. That happened because I could write only a little at a time and between times I would forget just what I had written.' I send it for what it is worth; the recollections of a woman over eighty years old who lived a very intense life where natural science was concerned.

She now lives alone in La Jolla. With the help of radio and of a daily reader she keeps abreast of the thought and activities of the times in a way that would shame many of the younger generation.

"Do not feel that you have to return these notes, and if you and Doctor Neal feel that some part of them might be of interest for publication, I shall be very glad to supply the mechanical assistance necessary."

This was accompanied by the original letter, referred to in the first paragraph from Mary E. Andrews to her niece, Mrs. Belknap:

"When Miss Ruth Dailey read to me her typed copy of my Penikese notes I discovered that I had told the same story twice in more than one instance. That happened because I could write only a little at a time and between times I would forget just what I had written. I wanted my letter to reach you at Pemaquid before you left there so that the friend who you say is so interested in Agassiz might read it."

The longer letter (dated September 1, 1931) from Mrs. Mary E. Andrews to Mrs. Belknap, is reproduced here in full because the Marine Biological Laboratory is "the direct descendent of the Penikese School."

"Perhaps you would like to hear a little about Penikese as I saw it in the summer of 1874. If I repeat some things already said, please overlook it.

"As I have said, it was Prof. Nelson of the O. W. U.[1] who engineered the matter for me and gave me the privilege of spending my Saturday mornings in the museum. The subject of co-education was just beginning to agitate the intellectual world and I was not admitted to any of the classes; but I was given a copy of Woodward's Recent and Fossil Shells, almost every genus named in it being represented in the U. collection, and allowed to browse around as I chose. Everything relating to Agassiz I read with the greatest avidity and when he was taken ill I watched the papers. The news of his death was in the evening paper, but your Grandfather, fearing I would not sleep if I knew the truth, gave an evasive answer to my questions. The next morning he told me. I burst into heart-broken sobs. But I was obliged to go to school, and that was well, for I was obliged to put the subject out of my mind to a certain extent.

"My application for admittance to the Anderson School of Zoology at Penikese was still in, but I had given up all hope of going when I received a letter saying that a vacancy having occurred, my application entitled me to fill it. Annie Hills and I had gone to the post office together, and when I opened the letter on the way home, I jumped entirely across the sidewalk. That was in June, and as the school was to open about the first of July, I had just time to make comfortable preparations for the trip.

"I should say that when Professor Agassiz died, his daughter-in-law, the wife of Alexander Agassiz, so overtaxed herself in caring for him—there were no trained nurses in those days—that she died from overstrain. Mr. Alexander Agassiz himself, losing his father and his wife in so short a time, broke down and was very ill. He recovered sufficiently to be with us towards the last, and meantime the work was well cared for by others, for the same corps of professors and teachers who gave their services to Agassiz gratis continued on through the second year. The School was discontinued after that.

"I was twenty-four years old in that summer of 1874, but I was small and strangers who didn't know better, thought that I was just sixteen.

"New Bedford was named as the point of departure from the main land and to New Bedford I accordingly went, and taking a room waited for word that the little boat which was to take me over to Penikese was ready. I soon discovered another young girl there who was bound for the same port. I think her name was Miss Warren. She was a very charming Southern girl who was engaged to be married to a young divinity student. We corresponded for a time after we separated.

"We were ahead of time in making the passage over, but there were a few others—Prof. Putnam and his wife and children, Prof. Mayer, Mr. Garman, general factotum, and some others. We had a rough time, but reached terra firma at last.

"Mr. Anderson, who gave the island to Prof. Agassiz, had his summer home there, a very ordinary frame dwelling. That was used by the professors and teachers. For the main body of students two long dormitory buildings had been erected, one for women and the other for men. They were connected in the central part by a building in which the lectures were given. We were told the numbers of our rooms in the letters which gave us our right to attend the school, so Miss Warren and I had no difficulty in finding them and we at once made ourselves at home.

"We had the place to ourselves for a day or two and then we saw the main body of students making a landing. In the midst was a young woman carrying a long botanical case with the name Susan Bowen painted on it with startling distinctness.

"One young man was David Starr Jordan, now so well known. He was both student and teacher, having in charge the subject of botany. He was tall, angular, always impressed me as made of

1 Ohio Wesleyan University.

iron. Two things were said about him. One was that he was "awfully" smart, and the other that he was engaged to be married to a young lady in Green Bay, Wis., where he had been lecturing on all the sciences known to man. That young lady was there at Penikese with her sister. Their table was near mine. Each of us had a table with glass and other utensils. Professor Agassiz had been most sadly cheated in the glassware. It seemed as though one couldn't even look at it too long without shattering it. I remember one day having an oblong glass dish before me partly filled with water and a number of tiny creatures. The room was quiet and I had not touched the dish when suddenly it crashed. The hermit crabs scurried around carrying their borrowed shells and the tiny bivalves snapped theirs open and shut, apparently in great consternation.

"Those whose duty it was to procure material for study were not very successful at first and for two weeks or more we had little besides sharks and skates. But I worked over the ill-smelling things with great enthusiasm. I opened the brain cavity of a little flounder and showed how the optic nerves were twisted so that both eyes were supplied with nerves enabling them to see even though the creature swims on its flat side with one eye rendered useless in consequence. That won the praise of Dr. Burt G. Wilder of Cornell U. who was one of our professors.

"It wasn't all sharks and skates, however. A bit of living coral was brought to the laboratory, the delicate little polyps swaying about in the water.

"One successful haul brought in great numbers of squids. They are similar to the cuttle fish except that the body is elongated, with a horny pen instead of the "cuttle bone". They were pleasant and satisfactory to work with. While still living, as they are taken from the water, opalescent hues play over the surface of the body. I took a large can of sea creatures in alcohol when I went home, and the squids in it lasted me a long time for demonstration. The ink bag was perfectly preserved and I made up the ink and used it in writing and drawing.

"As summer advanced into August, phosphorescent creatures began to multiply. Going out in a rowboat on a dark night the wake of the boat was a stream of light. Some of the creatures were taken up in glass jars and brought to the laboratory. One I especially remember was crystal clear, three or four inches long with delicate cilia along the body in lines. They decomposed the light as it played upon them and the creatures were so transparent that all of their internal organs could be easily seen. When they were in a dark room and the water was gently stirred, they shone with a pale, lambent green light.

"Of course there were "jelly fishes" galore and sea anemones, and star fishes; and one day a living "sea urchin" was brought to the laboratory, stretching out its "ambulachral feet" among its thorny spines.

"But it would take a good sized book to describe all the strange forms I became acquainted with during that wonderful summer, and perhaps I am carrying coals to Newcastle anyway, for you have been on the Atlantic coast so much that you may have seen all these and more besides. But it was a rare treat to me, and there's no hope of duplicating it out here on the Pacific; for the Gulf Stream is a far more powerful heating agent than its counterpart, the Japan Current which tries to warm us up.

"One more creature, however, or assembly of creatures, I want to speak of. That was the Physalia or "Portuguese Man of War." If you have not seen it, imagine an elongated membranous bag something like a toy baloon, with a frill along the upper side, all very brilliantly colored in purple and lavender. From the lower side there hangs down a mass, also in lavender and blue, made up of colonies of zoophytes. The membranous bag keeps the whole on the surface of the ocean.

"One of the professors who was especially kind to me was Professor Edward S. Morse, who was there with his wife and little boy. He was very genial and was a leader in all efforts at sociability. He was wonderfully skillful in making chalk drawings. He could use his left hand as easily as his right and it was interesting to see him draw a butterfly, for instance, drawing the two wings at the same time. The professors gave their services, and with two or three exceptions did not stay more than two weeks.

"Miss Bowen, who was about my age, I soon learned to like very much. She was very capable and brimful of enthusiasm. David Starr Jordan had a younger sister with him, a rollicking, fun loving girl whom I knew very well in Minneapolis a few years later—some twenty-odd years.

"So many memories crowd upon me that it is difficult to make a selection of reminiscences, and if I repeat things already said, please overlook it. I spoke of the illness of Mr. Alexander Agassiz's wife from overexertion in helping to take care of Professor Agassiz in his last illness, which resulted in her death, and of Mr. Agassiz's own severe illness in consequence. It fell to Professor Putnam to open the school. One who helped in many ways was Mr. Garman, an assistant in the Agassiz museum at Cambridge and a trusted aid to Professor Agassiz. I saw a good deal of him in Cambridge a few years later.

"It was planned by a number of the students to take a trip to the fishing grounds at Gay Head, Martha's Vineyard; but a dead calm settled down upon us and the captain of the little boat we were in proposed that we go to his house on a near-by island and wait for the breeze to freshen, which it would do about four o'clock in the morning. It was the best thing we could do. As we walked across the island I was hurrying ahead to catch up with some people I liked when I came upon Mr. David Starr Jordan and Miss Bowen. He was saying something in a sentimental tone about how short the time had seemed or how long, I don't remember. I hurried on and as I did so he said "Let's go over and get some Clethra". I kept on, of course, and when they came in a few moments later it was very evident that a romance had been settled. . . . . .

"Miss Bowen did not have a very long married life. As I remember, it was only a few years after her marriage that she died. It was not long before Mr. Jordan took to himself another wife whom I never had the pleasure of meeting.

"It was about this time that the conflict between religion and science began to rage. Agassiz by the very reverent way in which he opened the school was heralded by the religious world in a way that he did not always like. One of the students quoted him as saying that his life was devoted to science and that he had friends among the religious, but that he did not care to be 'patted on the head.'

"It was also the time when the theory of evolution began to grip the minds of thinkers. Agassiz held to the old idea that life came into the world by a succession of creations—that there was an age of protozoans, of radiates, of mollusks, of fishes, of the rich Carboniferous forests, etc. The Agassiz museum at Cambridge, Mass. was established by him as a grand illustration of his theory of the earth. When I visited it many years ago it had superb specimens arranged in a manner to illustrate his theory. I hope this arrangement has been retained.

"It was in its second and last summer that I spent at the School of Zoology at Penikese. It was never reopened again. When I saw Mr. Garman some years later he told me that when he left he packed up all of the equipment belonging to the Museum. He said that Mr. Anderson, having gotten as much advertisement out of it as he wanted, cared no more for it, and there were no funds available for running expenses. The last that I heard of the place, the two long laboratories were making fine dance halls for parties going there from the main land.

"Those two years at Penikese gave a tremendous impetus to the demand for studies of nature at first hand which had already shown itself. Students were no longer satisfied with text book descriptions of animals but demanded the animals themselves for examination. Educational methods were greatly enriched in consequence. . . . .

"The student body included some who were younger and more ignorant than I and others who commanded high places in the educational world. This did not seem strange to me. I thought it was in line with the democratic spirit which had led Agassiz to admit women in equal numbers and on equal footing with men.

"I have spoken of David Starr Jordan and his sister. The latter married in the course of a few years and came to the Twin Cities to live. Her son Paul was in one of my classes. Her brother was at that time Chancellor of Leland Stanford University. I cannot recall her married name. When Dr. Jordan visited her she gave a large reception for him and very kindly invited me.

"I may have spoken of the grief the death of Professor Agassiz was to me. I had read everything available about him and his work. My mind was completely saturated with information about them. . . . . Up to that time it was the greatest sorrow my life had known.

"I had often thought what a fine thing it would be to have a reunion of the Penikese students, and at the reception given to David Starr Jordan by his sister, I resolved to broach the subject to him.

" 'We do have reunions,' he said. 'I stopped to visit Professor Snow on the way here.'

"It was Professor Snow who discovered a successful way to combat the grasshopper plague in Kansas.

" 'Oh, but Professor Snow is distinguished,' I said. 'I mean a reunion that would let the lesser lights in.'

"And then came the most unkindest cut of all. Looking down at me from the lofty height of his superior inches, the Chancellor of Stanford University said, "Umm. They were all dim lights except a few who went there under Agassiz.'

"The cruel truth flashed upon me—that if Louis Agassiz had not died when he did, I never would have seen Penikese. Someone more worthy than I would have been selected to fill that vacancy—some college professor or normal school principal would have been preferred. It was after Agassiz died that applicants were admitted in the order of their application, and that was what gave me my chance. It did not help me to class the Stanford Chancellor as a snob intellectual. The sting of his revelation remained, and it persists to this day. I doubt if I ever fully recover from it.

"Professor Agassiz's mortal remains lie in the beautiful cemetery at Cambridge, Mass., where so many of America's illustrious dead are sleeping. The grave is marked by a block of granite from the Glacier of the Aar in his beloved Switzerland. When I visited it a delicate vine had begun to clamber over it.

Mary E. Andrews.
(Mrs. J. R. B.)

Thursday, Sept. 24th.

Since the above was written, Dr. David Starr Jordan, Chancellor emeritus of Leland Stanford University, has passed on to the Higher Life. A fall which he had some two years ago undoubtedly hastened the end. Towards the last he suffered from a combination of diseases—hardening of the arteries of the brain, diabetes and heart trouble.

If I had been told a few months ago that I would be deeply affected by his passing, I would not have believed it; but I was quite unnerved by it. It seemed like a sweeping away of all that had remained of that beautiful summer on the island of Penikese.

One statement that I made in the early part of my sketch of Dr. Jordan should be explained. I spoke of his being at Green Bay "where he was teaching all of the sciences known to man." That statement was based partly on a lecture I heard him give in which he spoke of the great number of subjects he was called upon to teach at Green Bay and partly on what I was told by Horace Bryan, who studied at Stanford a few years ago. Horace said that Dr. Jordan told the students in his classes that they might select any subject they wished and he would lecture upon it. In these days of specialization it is rare to find a man eminent in many subjects. Probably Dr. David Starr Jordan was the last great scientist whose mind ranged over so wide a field.

"Lord now lettest Thou Thy servant depart in peace." —*M. E. A.*

THE PARTICIPATION OF BONE IN THE NEUTRALIZATION OF INGESTED ACID

Dr. Lawrence Irving and A. L. Chute,
Associate Professor in Physiology and Fellow in Physiology, University of Toronto

Some time ago we suspected that CO_2 might be withdrawn from the bones during prolonged overventilation, but the loss of CO_2 from bone could not be demonstrated analytically. The idea that bone could contribute CO_2 to the blood during overventilation is only another way of regarding bone as capable of participating in the process of regulating the acid-base equilibrium of the body. There is a variety of evidence to show that bone composition is subject to change during prolonged metabolic disturbances, but the reports on the effect of ingested acid upon the mineral composition of bone are conflicting.

The main difficulties seemed to rest upon analytical methods and the number of animals which could be examined.

Rats, and later guinea pigs were supplied with up to 5cc. of 2N HCl per day, and the Ca, P, and CO_2 of femurs were determined. The average CO_2 content of the femurs of four groups of six rats each which had received acid was from 5 to 10% less than that of the corresponding groups of controls. In two groups of guinea pigs (which showed much less tolerance of acid), the average femur CO_2 content was 14 and 11% less. These changes are analytically significant, because the average difference between the right and left femurs in 55 pairs amounted to only 1.60%. Changes in Ca and P were not so significant.

The physiological significance of these results appears when it is considered that 10% of the CO_2 of the bones of an animal amounts to over 300cc. per kilo and represents the ability to neutralize from 1/60 to 1/30 of a mol of strong acid. Much of the physiological significance of this ability to participate in neutrality regulation depends upon how quickly the neutralizing process can occur. In these feeding experiments several days were necessary, but we feel on account of other observations that the bones can be regarded as relatively labile and capable of responding rather promptly.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 26.)

PARTITION COEFFICIENTS AND DIFFUSION OF SOLUTES IN HETEROGENIOUS SYSTEMS

Dr. S. C. Brooks,
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Solute molecules approaching the interface between two immuscible solvents can pass from one to the other if the component of their kinetic energy normal to the surface surpasses the maximum increase in potential energy which they must attain in passing from the one solvent to the other. This maximum increase may exceed the final difference in potential energy of solute molecules in the two solvents, and the latter may be either positive or negative.

Considering a given interface between two phases, solute molecules will pass across the boundary in one direction at a rate in moles per sq. cm. of interface per second (or other appropriate unit) which we may call the escaping tendency from phase 1 into phase 2. In like manner solute molecules pass from phase 2 to phase 1 at a rate which give the escaping tendency from phase 2. These escaping tendencies need not be proportional to the corresponding stoichiometric concentrations, and the ratio between the two may be called the escaping coefficient. The ratio of the two escaping coefficients at a given interface determines the partition coefficient between the two phases, but the rate of transfer of solute across the interface is determined by the algebraic difference in escaping tendencies, which in turn are the products: concentration X escaping coefficient. Partition coefficients do not therefore give adequate information in regard to the rates of passage of solute from one phase to another, but only as to the equilibrium conditions.

Theories of permeability are often based on the assumption that living cells are surrounded by a continuous layer of non-aqueous solvent; and models have been devised to represent living cells, using a non-aqueous solvent separating two aqueous phases.

The mathematical analysis of the relationship between escaping coefficients, partition coefficients and the rate of passage of solute (e.g. dye) from one aqueous phase through the non-aqueous phase ("plasma membrane") into the second aqueous phase ("cytoplasm" or "sap") has been made. It is assumed that the term permeability is used in its proper sense to denote the *rate* of passage of solute through the membrane; and not, as is so often carelessly assumed, to the *equilibrium* concentration in the cell.

The equations show that any given difference in partition coefficients between aqueous and non-aqueous phases may result in either an increase of a decrease in "permeability," or in first a decrease and later an increase. The nature of the difference in permeability is determined by the nature of the changes in the escaping coefficients. The latter are therefore the factors which we need to know in order to predict the permeability of artificial cells, and of living cells, if we assume that the latter do have a lipoid membrane. The equations also indicate the reasons for differences in permeability" produced by differences in the relative volumes of the three phases in the artificial model. The mathematical and theoretical analysis will form part of a paper about to appear in the *Journal of Cellular and Comparative Physiology*.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 26.)

ANTAGONISM OF METHYLENE BLUE FOR CN AND CO

Dr. M. M. Brooks,
Research Associate in Biology, University of California.

The hypothesis that methylene blue acts as a substitute for the respiratory enzyme when this is poisoned by CO or CN is generally accepted. Previous experiments have used such small organisms as yeast, bacteria, Paramoecia, and isolated tissues as muscle and nerve. The present experiments deal with larger animals, rats, to see whether inhalation of CO or CN could be antagonized by methylene blue. It was found that those animals which had been treated with methylene blue recovered in 36% of the time required by the controls which had not received the dye in the case of CN poisoning; and those animals which had received CO gas recovered in 57% of the time when the dye was injected. These results show that methylene blue could be used to antagonize the results of CO and CN poisoning. It would seem therefore that this dye would also act in this case as a substitute for the poisoned enzyme, enabling the transfer of O by means of the catalytic ability of the dye.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 26.)

THE MECHANISM OF THE ACTION OF ENZYMES

Dr. A. P. Mathews,
Professor of Biochemistry, University of Cincinnati.

Although extremely little total energy change occurs in the digestion of proteins, carbohydrates and fats, energy must be supplied for their digestion. If they are heated with water they hydrolyse. Enzymes produce the same hydrolysis in water at ordinary temperature. They must, therefore, be substances which can transfer energy from some source, unavailable without them, to the substrate. They have three sources of energy: 1. The extra energy in certain molecules of the solvent. Although the average temperature of the solvent may be no more than 38° some molecules have a kinetic energy equivalent to an average temperature far higher than this. This energy the enzymes presumably use; 2. The energy of oxygen; 3. Radiant energy.

Operating on this theory of digestion or hydrolysis my pupils, Dr. Hill, Dr. Boyd, Mr. Brown and Mr. Sigal have been able to make artificial systems which much resemble digestive enzymes in their action.

The first of these enzyme systems is hematoporphyrin, oxygen and light. This digests fibrinogen very quickly; serum albumin slowly; and edestin very slow or not at all. The action depends upon the combined presence of light, hematoporphyrin and oxygen. Very slow or no digestion takes place in light in a hydrogen atmosphere, although fluorescence occurs there as well as in oxygen. The fibrinogen is converted into an albumose and a protein coagulating at 76°. The change appears to be the same as is produced by thrombin and also by the fibrinogenase of rattle snake venom.

Dr. Hill has succeeded in hydrolysing serum albumin by means of dialuric acid and oxygen. An albumose, ammonia and carbon dioxide are set free. The active agent is alloxan. This must combine with the substance it acts on since it does not digest carbohydrates, as Mr. Gregory has found.

Mr. Brown has succeeded in hydrolysing starch with the production of dextrins and reducing sugars by ferrous salts and hydrogen peroxides; and Mr. Sigal has hydrolysed serum albumin to albumose and other products by the same reagent.

These results indicate that proteins and other substances exist in two or more forms differing in their energy content and so in their reactivity. The real equilibrium between the protein and the amino acids, of which it is composed, is probably, between the anakinetic form of protein and the anakinetic forms of amino acids. The amount of energy necessary to supply the katakinetic form of protein to make it reactive so that it will digest is just about that set free by the passage of its digestive products from the ana to the kata form. The examination of the total heat change of the system, which is extremely slight, may mislead to the conclusion that little energy transfer has occurred.

Enzymes and other agents act, according to this theory, by obtaining energy from some source, uniting chemically with the substrate; passing their energy over to the substrate, which then becomes reactive, while the inactive form of the enzyme now dissociates; and is reactivated either by kinetic energy of the solvent, by oxygen, or by radiant energy.

(This article is based on a seminar report presented at the Marine Biological Laboratory on July 26.)

NOTES ON THE BIOLOGICAL STATION OF INDIANA UNIVERSITY

Professor Will Scott

Director of the Station

The Biological Station of Indiana University located on Winona (Eagle) Lake, Indiana is in its thirty-eighth session. It operates as a division of the university summer school. This fact necessitates the offering of certain undergraduate courses. The course in limnology is open to graduate students and advanced majors in zoology.

The most important work of the station lies in the opportunities and the stimulation it offers for research. Two major lines of investigation are at present being developed, that of embryology under the general direction of Dr. G. W. D. Hamlett and that of fresh water biology under the supervision of the director of the Station.

Part of the investigators hold advanced degrees while others are candidates for them. One of the most interesting groups is composed of high school teachers who are not candidates for any degree but who prefer to spend their vacations in scholarly work. They have excellent libraries in a limited field and many correspondents both in America and abroad. It is the policy of the Station to encourage this group both for the value of their contributions and the enrichment it will bring to the teaching of science in our secondary school.

The following is a list of investigators with a statement concerning their problems.

G. W. D. Hamlett: Factors causing implantation of the embryo. Sixty (60) armadillos have been shipped from Texas to furnish experimental material. Various glandular extracts are being tried.

Blanche Foglesong: Nature and Development of the zona pellucida: A comparative study of the zona pellucida in different groups of mammals and the effects of various fixatives on the appearance of the zona.

Raymond Breneman: Effects of extracts of various endocrine glands on embryonic development. Chick embryo used as experimental animals.

James Plummer Schooley: Development of certain wild rodents chiefly six genera, and nine species of squirrels (Sciuridae). A collection of more than 1500 embryos has been made. The collection is especially rich in the early stages including eggs with polar bodies and cleavage stages. Development in this family differs in several particulars from that in the families of rodents usually studied.

Blanche E. Penrod: The amount and kind of food eaten by the bluegill (*Helicoperca incisor*) together with its rate of feeding and digestion. A bluegill weighing 25 grams, whose stomach is empty will eat about 2000 daphnids in a day. When the stomach is filled it takes from 31 to 34 hours (at room temperature) to digest the contents.

MARY K. SHOUP: Annual variation in form and reproductive rate in the Daphnia of Winona Lake.

DR. A. I. ORTENBERGER: The nature and origin of the organic deposits in the Indiana Lakes. Some new instruments are being designed for the study of the superficial parts of these deposits.

D. H. MINER: A study of the contribution of the various strata in the pelagic regions of a lake to its bottom deposits. A series of glass cylinders have been suspended in the lake by means of a concrete anchor and a submerged buoy. It is proposed to extend this study over at least ten years.

DR. IRA T. WILSON: The littoral deposits of Winona Lake.

LEONARD STRICKLAND: The early morphogemsis of the thymus on the pig.

HERSCHEL GIER: The nature and occurance of symbionts in insect ovaries, especially of the Homoptera and Orthoptera.

MYCHYLE W. JOHNSON: Behavior and morphology of nucleoli with especial reference to some of the Orthoptera and Chilopoda.

F. F. CARPENTER: Life histories of chironomids, chiefly of the genus Chironomus. Most of the material from the bottom of lakes of northern Indiana. Material has been secured also from Michigan, Wisconsin, Illinois, New York, England and Germany. Ten life histories including egg, larval instars, pupa and adult have been completed in series of fifty or more which gives ample material for the study of the different stages. The results indicate that the basic classification of this group will have to be revised. This work has been carried on for six summers.

WILL SCOTT: (a) the origin of "Marl islands" and certain post pleistocene modifications of lakes and streams. (b) In completing the study of the bottom fauna of Tippecanoe Lake and the comparison of this lake with Lake Wawasee a detailed map of the emergent and submerged aquatic plants is being made. (c) The influence of the hypolimnion on the epilimnion in lakes.

THE BEACH QUESTION AND THE STATEMENT IN THE FALMOUTH ENTERPRISE

In our last number we reprinted an article from *The Falmouth Enterprise*. This week we wish to comment on most of the statements that it contained. To bring out our points clearly we shall in each case first quote the paragraph to which we refer:

(1)

"A sub-committee of the general committee which is studying the adequateness of bathing beach facilities at Woods Hole met last night and heard seven or eight people who maintain that Woods Hole needs more beach privileges and made suggestions as to how to work for them. The committee will report Saturday to its general committee. It was announced that a public meeting will be held later."

The "committee" did not report to its "general committee" on Saturday—and it never had any intention of doing so.

(2)

"Among Woods Hole property owners adjacent to the Bay Shore beach are the estates of the late Hector J. Hughes, Dr. Oliver Strong, Dr. Otto Glaser, Dr. Manton B. Copeland, Dr. Addison, Dr. E. N. Harvey, Dr. R. Chambers, Dr. Frank R. Lillie, Mrs. E. G. Gardiner, Edward A. Norman. Many of them have appeared in conference before the sub-committee of the Beach committee, and members of the group prepared the following statement for the *Enterprise*:"

This paragraph strongly infers that the statement was drawn up more or less officially by the group of property owners, or at least that it was done with their knowledge and approval. That is not the case. Some of them did not know anything about it before the statement was printed. In fact, we have reason to believe that it was prepared by one or two individuals without the knowledge or consent of most of the property owners mentioned above. If this is the case. The *Falmouth Enterprise* should have *insisted* that its author's name accompany the statement.

(3)

"Recently 'THE COLLECTING NET, a weekly devoted to scientific work' distributed a broadside in Falmouth which had very little mention of scientific work in it, but was largely devoted to the discussion of the beach situation in Woods Hole."

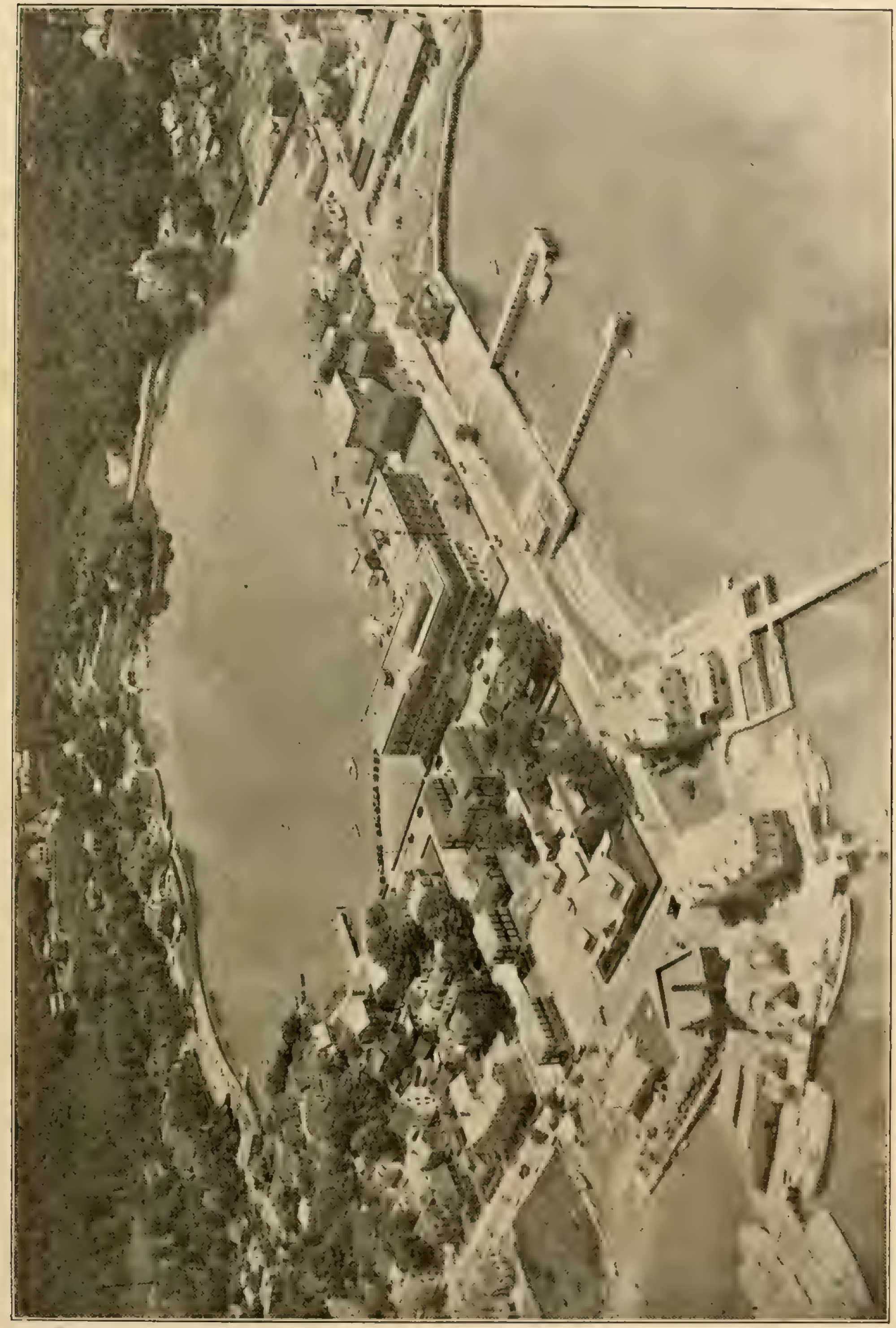
Our sub-heading has been incorrectly quoted. It should read "A Weekly Publication devoted to the Scientific Work at Woods Hole."

There is no reason why the "broadside" should have had *very much* mention of scientific work. It contained all the local news which had been printed in the issue of THE COLLECTING NET for July 16. Properly, it made no mention whatever of scientific work. It is not true that it was "largely devoted" to the beach question. Actual measurement shows that the text concerning the beach occupied less than one-sixth of the space (or one-twelfth when the advertising section is taken into consideration.)

(4)

"'THE COLLECTING NET states that the beach

(Continued on page 180.)



THE BIOLOGICAL LABORATORIES AT WOODS HOLE IN 1928

The Collecting Net

A weekly publication devoted to the scientific work at Woods Hole.

WOODS HOLE, MASS.

Ware Cattell .... Editor

Assistant Editors

Florence L. Spooner   Annaleida S. Cattell
Vera Warbasse

Contributing Editor to Woods Hole Log
T. C. Wyman

The Collecting Net Scholarships

In consultation with the heads of the courses at the Marine Biological Laboratory we have decided that it is desirable to establish an extra scholarship of $100.00. This year there will be six available instead of five; one each is to be assigned to the classes in embryology, physiology, protozoology and botany, and—owing to its greater number of students—two to the class in invertebrate zoology. The award of the scholarships will be placed entirely in the hands of the individuals in charge of the various courses. This arrangement will eliminate the delicate and difficult task of weighing the merits of a good student in one class against those of one in another.

It now becomes necessary to obtain six hundred dollars instead of five hundred, each summer. We believe, however, that the value of the scholarships in assisting worthy students (and therefore the Laboratory itself) is now so well realized that the task that we have set for ourselves will not be an impossible one. In fact it should not be more difficult to accumulate money for six scholarships than it was to obtain the money for five when we first established them in 1927.

The meeting of the Corporation of the Marine Biological Laboratory will be held on the coming Tuesday at 11:30 A. M. It is important that as many members of the Corporation attend it as possible, because they have the responsibility of selecting and electing 10 trustees.

DIRECTORY SUPPLEMENT

MARINE BIOLOGICAL LABORATORY

Students of the Course in Invertebrate Zoology

Aldinger, Lenore grad. bot. Wisconsin. H 7.
Anthony, Genevieve R. grad. zool. Pennsylvania. H 7.
Axford, Dorothy grad. asst. zool. N. J. Col. Women. Larkin, Woods Hole.
Bates, M. N. Hamilton. Dr attic.
Belding, H. S. asst. zool. Conn. Agri. K 5.
Berkenfeld, Charlotte G. grad. zool. Col. City N. Y. McLeish, Millfield.
Buchheit, J. R. grad. asst. zool. Illinois. Dr attic.
Couch, Mary L. res. asst. biol. Elmira. H 3.
Crooks, K. B. M. instr. biol. Hampton Inst. Ka 4.
Diack, Marion Oberlin. Hilton, Water.
Dibble, U. E. grad. asst. zool. Yale. Dr attic.
Elliott, A. M. teach. fel. biol. New York. Cowey, School.
Foltz, Ruth G. Oberlin. Hilton, Water.
Goffin, Catherine E. Brown. Goffin, Millfield.
Gray, Beatrice grad. zool. Iowa State. Hilton, Water.
Grierson, Margaret C. grad. zool. Mount Holyoke. H 8.
Haffner, W. Wabash. K 9.
Hamilton, Mary A. Elmira, H 4.
Havey, C. B. Acadia. Densmore, School.
Henderson, Ruth E. Goucher. H 7.
Hoover, W. K. asst. biol. American. Dr attic.
Huff, G. C. grad. zool. Iowa. K 7.
Ives, P. T. grad. asst. comp. anat., emb., gen. Amherst. Dr attic.
Jacques, R. H. Ohio Wesleyan. Ka 1.
Jonas, Marion grad. biol. N. J. Col. Women. H 6.
Kleinholz, L. H. K. instr. anat. Colby. Ka 22.
Kohn, H. I. grad. zool. Yale. K 6.
Larrabee, M. G. Harvard. Silvia, Buzzards Bay.
Ling, S. W. grad. limn. and entom. Cornell. Dr 9.
Lippy, Grace E. instr. biol. Hood.
Livengood, W. F. Wabash. K 9.
Logan, Amy D. Wilson. Nickerson, Millfield.
Lumer, H. grad. asst. zool. Western Reserve. Silvia, Buzzards Bay.
Manuel, Beth Dalhousie (Halifax). W d.
Meyer, Adelphia M. grad. zool. Peabody. H 4.
Olsen, M. W. poultry biol. U. S. Dept. Agri. Ka 23.
Owen, Cora R. Vassar. Grinnell, West.
Penn, A. B. K. C. grad. phys. Hopkins. D 303.
Pliske, E. C. asst. zool. Minnesota. Ka 2.
Rankin, J. S., Jr. Wesleyan. K 5.
Reed, S. C. Dartmouth. K 7.
Rees, Olive L. asst. bot. Wisconsin. H 7.
Sandnes, G. C. grad. biol. Col. City N. Y. Dr.
Schloemer, C. L. Beloit. Dr attic.
Schoenborn, H. W. De Pauw, Ka 1.
Setty, L. R. instr. biol. Park. Higgins, Depot.
Shoemaker, H. H. instr. biol. Earlham. Stewart, School.
Stearns, Mary L. Smith. Thompson, Water.
Sures, Pearl M. grad. biol. Minnesota. W a.
Tobias, Belle C. grad. biol. Wellesley. H 3.
Tukey, Gertrude R. Smith. Thompson, Water.
Turner, R. S. Dartmouth. K 7.
Warren, M. R. De Pauw. Ka 1.
Wells, Josephine grad. zool. Barnard. Johlin, Park.
Zinn, D. J. Harvard. Sydell, Glendon.

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
Aug. 6	7:50	8:13
Aug. 7	8:37	9:07
Aug. 8	9:28	10:04
Aug. 9	10:22	11:04
Aug. 10	11:21	——
Aug. 11	12:08	12:22
Aug. 12	1:12	1:25
Aug. 13	2:14	2:24
Aug. 14	3:11	3:21

ITEMS OF INTEREST

Dr. Martin H. Fischer, professor of physiology at the University of Cincinnati, was awarded an honorary degree of doctor of science by Wittenberg College.

Dr. Dennis R. Hoagland, professor of plant nutrition at the University of California has been elected president of the American Society of Plant Physiologists.

Dr. Francis O. Holmes, who has been working on insect protozoa at the Boyce Thompson Institute for Plant Research, has been appointed associate member of the Rockefeller Institute for Medical Research.

The New York Zoological Park has set aside a substantial one-story brick building for tropical research under the direction of Dr. William Beebe. The main laboratory room is thirty-six feet long and twenty-six feet wide. The building contains ample library and storage space.

Dr. Henry E. Crampton, professor of zoology at Barnard College is spending his vacation in Woods Hole.

Dr. E. C. Schneider is taking a sabbatical leave of absence for a year from Wesleyan University where he is professor of Biology. Dr. Schneider has been working on the influence of high altitudes and low oxygen on man, on physical fitness and on aviation physiology.

Dr. C. D. Snyder, professor of physiology at the Johns Hopkins University and a frequent visitor in Woods Hole, and his family are spending the summer visiting relatives and friends in Holland and Germany. Dr. Snyder is acting as a delegate from the University of California at the celebration of the 300th anniversary of the University of Amsterdam. He also plans to attend the 15th International Physiological Congress which convenes in Rome early in September.

Friends of the late Dr. Jacques Sither, director of the Biological Station at La Rochelle, France, from 1907 until its discontinuation during the war, will be interested to know that his son, Mr. J. A. Sither, is spending the summer at Woods Hole. Mr. Sither first came to this country last year and has been studying at Kimball Union Academy. He plans to enter Wabash College this fall. Mr. Sither is working in the Supply Department of the Marine Biological Laboratory, collecting and preserving tunicates in which he is particularly interested. —*C. E. B.*

FLYING FISH AT THE MUSEUM

Through the kindness of Mr. McInnis, Manager of the Supply Department, a fine specimen of the Atlantic Flying Fish (Cypselurus Heteruene) Rafinesque, has been secured by the Museum, and is now on exhibition there. This specimen was caught in the trap of Norman Benson near Quissett. It is nearly a foot in length, and while not considered common at Woods Hole, there are several records of its capture. It is commonly found in the South Atlantic, and has even strayed as far as New Foundland.

—*George M. Gray, Curator.*

Dr. H. C. Urey of Columbia University has been appointed managing editor of the new *Journal of Chemical Physics* which will initiate publication in January, 1933, under the auspices of the American Institute of Physics.

DIRECTORY SUPPLEMENT

MARINE BIOLOGICAL LABORATORY

Investigators

Ashley, Alta res. asst. biochem. Cincinnati. Br 342. Eldridge, Woods Hole.
Borodin, D. N. ind. inv. Br 2. Briggs, High.
Bridges, C. B. res. asst. Carnegie Inst. Washington. Br 324. McLeish, Millfield.
Carpenter, R. L. assoc. anat. Columbia P. and S. Br 217. A 209.
Conklin, E. G. prof. biol. Princeton. Br 321. High.
Goldsmith, E. D. asst. zool. Harvard. Br 315. Hilton, Millfield.
Grand, C. G. tech. asst. biol. New York. Br 338. McLeish, Millfield.
Herrick, E. H. prof. biol. La State Norm. Col. Br 217J. D 308.
Hitchcock, H. B. Williams. O M 28. Waldron, School.
Kiess, Mary D. Pennsylvania. Br 217 h.
Kille, F. R. grad. zool. Chicago. Br 224. Ka 24.
Klein, H. res. fel. biochem. Hopkins. O M 1. McLeish, Millfield.
Lewis, I. F. Miller prof. biol. Virginia. Bot. Hubbard, Center.
L'Heritier, P. Rockefeller fel. Paris. Br 333. Avery, Main.
Morgan, T. H. prof. biol. Calif. Inst. Tech. Br 320. Buzzards Bay.
Ormsby, A. A. res. asst. sanit. eng. Penn. State Col. O M Base. D 206.
Parks, Elizabeth K. instr. histol. Boston Med. O M 29. H 8.
Pandit, C. G. asst. dir. King. Inst. Preven. Med. (India). Br 328c. White, Millfield.
Saeger, A. fel. biol. Nat. Res. Council. Br 110. McLeish, Millfield.
Schmidt, Ida G. res. fel. endocrin. Cincinnati. Br 341. McLeish, Millfield.
Suozzi, S. asst. physics. Memorial Hosp. (N. Y.). Br 307. Dr 5.
Thomas, T. B. grad. asst. Br 218. Ka 24.
Weiss, P. A. res. fel. Yale. Br 123. D 311.

WOODS HOLE LOG

THE BEACH QUESTION

(Continued from page 174.)

lots on Bay Shore had "been reserved for the use of five investigators." We find this to be incorrect. The Fay Estate never reserved these lots, but put them in the open market. They were then bought by the present owners.' "

Again we have been incorrectly quoted. The news story (not an editorial) reporting on the first beach committee meeting stated that a map drawn on the blackboard "showed that the finer and larger section of the beach had been reserved for the *private use* of five investigators at the Marine Biological Laboratory." This is correct. Until an editorial note concerning it appeared in The Collecting Net the lower post of *the* fence proudly bore the message "The beach beyond this fence is private. Please do not trespass." Thus the use of the beach in front of the lots owned by Professors Brooks, Glaser, Addison, Harvey and Chambers was taken away from the residents of the town, members of the laboratories and summer visitors alike. We understand that Professor Chambers is not in sympathy with this undemocratic arrangement (he recently returned from an extensive trip through Soviet Russia.)

(5)

" 'The statement that 'Falmouth owes Woods Hole a beach' is misleading to those not familiar with the situation, and puts our selectmen in a wrong light, as it suggests that at present there is none. As a matter of fact Woods Hole has six beaches serving various groups of tax payers.' "

This paragraph gives the impression that the words "Falmouth owes Woods Hole a beach" were editorially used in The Collecting Net. They were not. In its last number The Net simply remarked in a news account that an individual had made this statement at the meeting of the Beach Committee.

(6)

" '1. Nobska Beach, a very fine one, is used by all the residents of the Nobska Point region and some of the Laboratory workers.

" '2. Juniper Point Beach, owned by Mr. Crane serves a group of bathers there.

" '3. Penzance Point Beaches, of which there are two, plus many private bathing piers take care of all the residents on the point.

" '4. Gansett Beach, is especially set aside for all the owners of property on that part of Crow Hill known as Gansett and numbering 29 cottages.

" '5. A beach on Quissett Harbor used by the cottagers on the private road.

" '6. The Bay Shore Beach, open to any resident of Woods Hole as stated in the deed.

" 'As well as these beaches over twenty-five residents on Vineyard Sound and Buzzards Bay shores have their own bathing facilities and do not need to use the other beaches.' "

Statement "6" is misleading. Only a section of the Bay Shore Beach is open to the *residents* of Woods Hole. So far as we know the scientific workers and other summer visitors have never had an invitation to use the beach adjoining "Lot X." No one has yet objected to their taking advantage of it, but the privileges that they have assumed are theirs can be legally withdrawn at any time.

(7)

" 'It is the Bay Shore Beach to which the editorials in The Collecting Net refer. The problem here is really not one of bathing at all, as this is excellent, but entirely a matter of more sand space for sunners. As the number of people using the beach scarcely reaches 50 at even the most popular hours, and is below 80 on Saturdays, it can be seen that a relatively small number of tax dollars is involved.' "

We suspect that even the lot-holders take advantage of the sun when they bathe. Why should not the rest of us? Soon a photograph will be reproduced in The Net proving conclusively that the above figures are not correct.

(8)

"A movement is on foot in Woods Hole which may result in action looking towards taking a beach for public use by eminent domain.

"Originally broached last summer by Dr. Caswell Grave and Ware Cattell, editor of The Collecting Net, on July 11 a committee of 20 met to discuss beach facilities at present available in Woods Hole."

The subject was first taken up in 1930, and Dr. Grave played no part at all in initiating it. Nor did The Collecting Net. The beach situation was formally presented by three senior investigators at the Marine Biological Laboratory (all of whom owned property and two of whom were Trustees of the Institution) at a meeting of the Woods Hole Protective Association. Dr. Grave happened at that time to be President of this organization, and he later appointed a committee (of which Dr. Manton Copeland was chairman) to find ways and means of establishing a continuous patrol on the Bay Shore Beach. It was understood that the lot-holders would take no steps to close the beach in front of their cottages if such a patrol were established. The fence, however, appeared in June last year while arrangements for the patrol were being completed. The offensive fence stirred a long-time research worker

(Other pages of the Woods Hole Log can be found on 182 and 184)

WOODS HOLE LOG

(who is a Trustee of the Laboratory) to prepare a statement upon the limitation of bathing facilities which was printed in the initial issue of The Collecting Net last year. Later in the summer a group of several interested individuals held a single informal meeting. It was only after much persuasion that Dr. Grave consented to attend the meeting, and he did so as ex-president of the Woods Hole Protective Association. Again this year Dr. Grave was injected into the discussion against his will.

(9)

"The committee which is considering Woods Hole beach facilities is composed of Dr. R. P. Bigelow, Dr. R. A. Budington, Dr. Robert Chambers, Dr. E. R. Clark, Dr. Manton Copeland, Mr. Robert Goffin, Dr. H. B. Goodrich, Dr. Benjamin Grave, Dr. Caswell Grave, Dr. L. V. Heilbrunn, Mr. Thomas Larkin, Mr. E. M. Lewis, Dr. Edwin Linton, Mr. James McInnis, Dr. Charles R. Packard, Dr. Fernandus Payne, Dr. A. C. Redfield, Dr. C. R. Stockard, Dr. O. S. Strong, Captain John J. Veeder.

"A sub-committee was appointed consisting of Dr. E. R. Clark, Dr. H. B. Goodrich, George A. Griffin, Thomas E. Larkin, Dr. C. R. Stockard.

"Projects suggested for the committee's consideration:

"(1) Purchase of the beach rights of Lot X (Miss Fay's Deed of Trust) and Dr. Oliver Strong's lot, containing the bathhouse.

"(2) Purchase of the beach rights of four lots belonging to Dr. S. C. Brooks, Dr. Otto Glaser, Dr. W. H. F. Addison, and Dr. E. N. Harvey.

"(3) Purchase of the beach rights of the Brooks, Glaser and Addison lots and expenditure of $1,000 to improve the beach."

The "projects" (worded a bit differently) were presented by The Collecting Net, as "a more or less hypothetical situation," and not by a member of the sub-committee. Further, no part of the bathhouse stands on Dr. Strong's lot.

(10)

"The present public bathing facilities at Woods Hole were provided by Deed of Trust of Miss Sarah B. Fay, accepted by the town at annual town meeting in February 1928. All "inhabitants of that part of Falmouth known as Woods Hole as make it their home" already are guaranteed in perplexity bathing privileges, with right to use 15 lockers in the existing bathhouse and right of way to the beach.

Perplexity!

(11)

"Miss Fay, carrying out the wishes of her late father, Joseph Story Fay, and late brother, Henry H. Fay, original owners of the property, set aside "Lot X", forty feet wide to provide bathing opportunities for all inhabitants of Woods Hole on the Bay Shore."

"Lot X" is "two hundred feet, more or less" in width.

(12)

"The acceptance of Miss Fay's benefaction, was moved and championed at the 1928 town meeting by two Woods Hole men now serving on the "Beach Committee," Thomas E. Larkin and George A. Griffin."

It was a wise decision on the part of the Chairman to appoint Mr. Larkin and Mr. Griffin as members of the sub-committee, because they made a painstaking study of the bathing facilities in 1928.

(13)

"Shortly after Miss Fay executed this Deed of Trust, the property was placed on the market and sold, subject to this restriction, to Dr. E. B. Meigs who is now trustee under the deed.

"The town has no expense in connection with this beach to Woods Hole inhabitants and the bathhouse is maintained by the trustees."

Since no expense has yet been entailed, the town of Falmouth might well see the wisdom of appropriating money to purchase beach rights if the people in Woods Hole are convinced that this step is necessary.

We believe that *The Falmouth Enterprise* deserves the widespread criticism that it has brought upon itself because of the obvious propaganda in the article and many misstatements of fact that appear in it.

Miss Vera Warbasse and Edgar Craig of Falmouth Heights were sailing together on Tuesday afternoon and amused many people by getting stuck in the mud in Little Harbor near the Luscombe estate. Their many friends were glad that these seasoned sailors were able to detach their craft from the mud without seeking the assistance of the U. S. Coast Guard.

Mrs. Annie Nathan Meyer is the author of "Black Souls," a play in 6 scenes which was performed at the Provincetown Play House in New York last March. It contains a foreword by John Haines Holmes. The cost of the paper bound book is 75 cents—the cloth bound, $1.50. Orders for the book may be left with Mrs. Meyer or The Collecting Net office.

(Other pages of the Woods Hole Log can be found on 182 and 184.)

WOODS HOLE LOG

Those who were at the Penzance Forum last Sunday witnessed a knockabout, headed east, sail across both ledges in the hole. Luckily it missed the rocks in the first one and reached safe waters. But then it cut the red can at Broadway and went right across red ledge. It did not seem possible that they would miss the rocks in both ledges, but Providence evidently was guiding them because even then they struck no rocks. Having spent a peaceful night in Woods Hole Harbor, they started the next morning to go back through the hole. They evidently had not profited by reading their charts because they repeated their same maneouver going across red ledge again. This time Lady Luck deserted the sailboat and they hit a rock fast and firm. The Coast Guard boat had to pull them off. The observer could see them and hear them yelling to the Coast Guard boat. They evidently did not want to risk hitting any more rocks, for they were safely towed through the hole to the bell buoy in the bay, far from any rocks. —*V. W.*

Dr. H. B. Bigelow, head of the Oceanographic Institution, combined various parts of diving suits making a novel new one. An expert in the subject said it defied the "laws of diving" and that a man would promptly die if he made use of such an outfit. However, the suit was satisfactorily used for a month, the diver being able to comfortably walk around on the bottom of the sea. —*V. W.*

The Island Airways carried over a thousand people during their first month. The first week the average number of passengers which they carried a day was thirty. The number then increased to sixty, and now they have reached the eighties and nineties. —*V. W.*

Mrs. Virginia Knower Elmendorf was desirous of seeing the races at the Edgartown Regatta. The only way she could fit it in was by flying. To get back from Edgartown to a picnic that evening, on the Weepecket Islands, she was dropped there for the small extra charge of one dollar. The pilot had a hard time starting the plane after he had landed Mrs. Elmendorf, and was almost persuaded to join the picnickers. —*V. W.*

Pilot Moon scared many people on Sunday. He was "zooming" over Woods Hole and made the lowest point of his "zoom," the square by the railroad dock, coming within 100 yards of the ground. —*V. W.*

Warner Oland, motion picture star from Hollywood, arrived in Woods Hole by boat recently on his way to Oak Bluffs. He is the actor who took the part of Charlie Chan, the Chinese detective, in various motion pictures that have been made from novels by Earl Derr Biggers. He will also be remembered for the part he played in "Shanghai Express." —*T. C. W.*

(Other pages of the Woods Hole Log can be found on pages 180 and 182.)

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THE COLLECTING NET

Vol. VII. No. 8 SATURDAY, AUGUST 13, 1932 Annual Subscription, $2.00 Single Copies, 25 Cts.

PHYTOPLANKTON OF ISLE ROYALE LAKE SUPERIOR

(The Seminar Report of Dr. William Randolph Taylor)

A few samples of phytoplankton were obtained by J. L. Lowe during the biological survey of Isle Royale under the auspices of the state of Michigan. These came from small lakes on the island, from narrow arms of Lake Superior penetrating valleys of the island, and from off-shore in the open lake.

The latter group of samples showed limnoplankton practically unmixed by littoral contaminations. The population was dominated by *Dinobryon divergens* and *D. stipitatum*, with an important diatom element in which Asterionellas, *Fragilaria crotonensis* and *Rhizosolenia eriensis* were significant; the only other frequent types were *Botryococcus* and *Westella*. These records for late summer from Lake Superior are apparently unique; comparison with the little know floras of Lakes Michigan and Erie suggests that at time of sampling Lake Superior differed in a greater prominence of Dinobryons.

The samples from the arms of Lake Superior showed a mixture of (*Continued on page* 194)

VITAL COLORATION OF PROTOPLASM

Dr. Robert Chambers

Professor of Biology, Washington Square College, New York University

The existence of a plasma membrane as a differentiated layer distinct from the cytoplasm beneath it has been already fairly well established. Probably the most striking proof is that a dye, such as phenol red, will not penetrate a cell from without but when injected into a cell readily diffuses through it and will not pass out. The plasma membrane is empermeable to the dye both from within and from without while, on the other hand, the internal cytoplasm is freely permeable to it.

An additional bit of evidence of a more morphological nature is the fact that cells can be sub-cooled far below their internal freezing point while embedded in solid ice. Only when a microscopic icicle is introduced into the interior of the cell by means of a micropipette will internal freezing take place. Evidently there exists a structure at the surface of protoplasm which prevents initiation of internal freezing from the presence of ice on the outside.

It is difficult to determine the consistency of the

M. B. L. Calendar

TUESDAY, AUGUST 16, 8:00 P. M.

Seminar: Dr. Daniel Raffel: "Gene Mutation in Paramecium aurelia."

Dr. C. B. Bridges: "Chromosome Maps of Drosophila."

Dr. A. H. Sturtevant: "A New Unstable Translocation in Drosophila."

FRIDAY, AUGUST 19, 8:00 P. M.

Lecture: Reynold A. Spaeth Memorial Lecture: Professor Dr. R. Goldschmidt, Kaiser Wilhelm-Institut fur Biologie, "Genetics and Development."

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plasma membrane mainly because of the presence of extraneous enveloping materials. These materials not only complicate results of operations with microneedles but also those of treatment with salt solutions. For example, $CaCl_2$ has a coagulating action on these envelopes while NaCl tends to dissolve them. These salts may have an opposite effect on the plasma membrane underneath. That this latter assumption has some evidence of being true can be shown in mature, unfertilized sea urchin eggs. With microdissection needles these eggs can be stripped of their extraneous enveloping materials to the extent of being rendered practically naked i. e., with plasma membrane exposed. Immersed in an isotonic solution of $Ca\ Cl_2$ these naked eggs can be pulled about, distorted and pinched into segments which instantly round up when released. The eggs and their fragments behave like droplets of oil. With their extraneous envelopes on they would have been stiff and brittle.

On the other hand, NaCl and KCl soften the envelopes and erode the plasma membrane.

The internal cytoplasm behaves like the external envelopes to $CaCl_2$ and NaCl.

In studying the permeability of a cell to dyestuffs one must take into account two factors, (1) selective permeability to the plasma membrane and (2) conditions within the internal protoplasm which may or may not permit the entrance of substances to which the plasma membrane may be freely permeable. To many dyestuffs the cell behaves as if there were no intervening plasma membrane. For example, the staining of a cell with neutral red appears to depend entirely on the relative acid-base reactions of the cell interior and of the medium in which the cell is immersed. If the external medium is more acid than the cytoplasm no dye accumulates within the cell, not necessarily because of the plasma membrane but because the constitution of neutral red is such that between two contiguous phases it tends to accumulate in the one which is more acid. Methyl red behaves in the reverse manner.

One more condition must be cited, viz., the metabolic activity of the cell. For some reason, at present unknown, the secreting kidney cell is freely permeable to phenol red. This property is unaffected by variations, within limits, of the acidity of the environing medium. However, if the *vitality* of the cell is reduced, e. g., by narcotics, cold, etc., the cells will not take up any phenol red. In contrast to this narcosis does not prevent vital staining of the cells with neutral red.

In conclusion we can state that, although we have strong exidence for the existence of a differentiated plasma membrane on the surface of protoplasm, we have no right to consider that the selective permeability of a cell is exclusively the property of the plasma membrane.

(This article is based on a lecture presented at the Marine Biological Laboratory on August 5.)

PHYTOPLANKTON OF ISLE ROYALE LAKE SUPERIOR

(Continued from page 193)

heleoplankton with littoral elements. *Anabaena Lemmermannii, Ceratium hirundinella,* Tabellarias and *D. cylindricum* appeared as important elements, but the flora varied considerably in different localities.

The lakes on the island itself are represented by samples from Wallace and Sargent lakes. These were filled with clear brown water over a muddy bottom with emergent rocks; the first had a floating sedge margin, the latter a shore of sandy mud. The floras were on the whole poor; samples from the central part of Sargent Lake gave a population which contained elements characteristic of heleoplankton as well as of the littoral, but with *Anabaena Lemmermannii, Ceratium hirundinella* and *Tabellania fenestrata* as important constituents. This produced a marked resemblance with the flora of the arms of Lake Superior.

An inspection of the limited literature shows that critical and frequent analyses of the phytoplankton are needed, to be made at places which would advantageously disclose any differences in the population throughout the Great Lakes chain.

—*Hannah T. Croasdale.*

(A summary of a paper presented at the Marine Biological Laboratory on August 2. It was submitted to Dr. Taylor for approval before publication.)

CYTOLOGICAL FIXATION WITH THE LOWER FATTY ACIDS, THEIR COMPOUNDS AND DERIVATIVES

Dr. Conway Zirkle

Associate Professor of Botany, University of Pennsylvania

Fixation images can be divided roughly into two classes, i. e. acid images and basic images. In the former the nucleus of the resting cell is surrounded by a membrane and consists of a chromatin reticulum about, but not in immediate contact with, a centrally located nucleolus. If the fixing fluid is very acid (pH 1.0-3.0) the nucleolus will contain vacuoles and will be so fixed that it will not be stained by the iron-alum haematoxylin technique. In dividing cells the chromosomes are preserved and mordanted and the spindle fibers are distinct. The cytoplasm fixes as spongioplasm and all mitochondria are dissolved. If NaOH or KOH is added to a 2% solution of H_2CrO_4 until the mixture reaches pH 4.0 the fixation images given by the fluid will be as described above except that the nucleolus will be mordanted and will stain as heavily as the chromatin. If more hydroxide is added until the pH becomes 4.8 the entire character of the fixation image is changed. The new image is provisionally labeled "basic" although the fixation occurs on the acid side of neutrality. In the basic image all chromatin and spindle fibers are dissolved. The nucleus fixes as a globule of nuclear lymph about and in intimate contact with the heavily staining nucleolus. The cytoplasm fixes as hyaloplasm and mitochondria are preserved. If the solution is brought to pH 4.8 with copper hydroxide the two images overlap and both chromatin and mitochondria are preserved.

Formaldehyde gives a basic fixation image even when combined with compounds of chromium whose fixation images are normally acid while acetic acid and the acetates, when added to the chromates, produce acid images regardless of the pH of the mixture. In spite of the fact that acetic acid is one of the most destructive of cytological reagents it is at present a component of practically all fixing fluids designed to preserve chromatin. The problem arises: Are there acids which combine the advantages of acetic acid with none of its disadvantages?

The following four series of interlocking acids were investigated:

1. Formic-Acetic-Propionic-Butyric-Valeric.
2. Acetic-Trichloracetic.
3. Formic-Glycollic-Glyceric-Gluconic.
4. Glyceric-Lactic-Propionic.

For convenience these acids can be arranged in the order of their fat solubility determined by their partition coefficient between ether and water. Thus—valeric, butyric, propionic, acetic, formic, trichloracetic, lactic, glycollic, glyceric and gluconic. Each acid used alone gives the acid fixation image. Combined with formaldehyde, however, they give two distinct images, i. e. those from valeric to formic give the acid image, those from trichloracetic to gluconic the basic. The copper salts of all of the acids give the acid image, but with formaldehye only those from copper valerate to copper acetate give this image. The salts from copper formate to copper gluconate with formaldehyde give the basic image. The nickel salts alone are not fixatives, but with formaldehyde give the basic image except that with nickel valerate and nickel butyrate no mitochondria are preserved.

The copper salts of the acids from valeric to formic when combined with copper bichromate give the acid image. The copper salts of trichloracetic and lactic acid with copper bichromate give the basic. The corresponding nickel salts with nickel bichromate give the same images as the copper salts except that in the acid images the material of the nucleolus is mordanted so that with haematoxylin it stains darker than chromatin. This image is useful in an investigation of the rôle of the nucleolus in cell division.

The above images can be explained by assuming that the different components of fixing fluids penetrate at different rates and that the first chemical to reach the cell determines the fixation image. Formaldehyde would then penetrate slower than the acids, valeric to acetic, (formic acid seems to penetrate more rapidly than any other acid) but faster than those from trichloracetic to gluconic. The copper salts of the acids, valeric to acetic, penetrate more rapidly than formaldehyde while the other copper salts penetrate more slowly. Formaldehyde penetrates faster than any of the nickel salts. Copper bichromate penetrates at a rate between those of copper formate and copper trichloracetate, while nickel bichromate penetrates at a rate between those of the corresponding nickel salts.

(A summary of a seminar report presented at the Marine Biological Laboratory on August 2.)

REVIEW OF THE SEMINAR REPORT OF DR. ZIRKLE

Dr. C. D. Darlington

Cytologist, John Innes Horticultural Institution

Fixatives react with the different cell constituents so as to make them capable of absorbing stains differentially. Dr. Zirkle has shown that the most important discriminating factor in their reactions is the pH of the fixative. Thus with a very acid fixative (pH 1.0-3.0) the chromosomes but neither the nucleolus nor the mitochondria are stained with iron-haematoxylin while with a fixative more basic than pH 4.8 the reverse is the case. This, however, is only true in the presence of Na and K and CrO_4 ions. Other combinations of bases and acids have different ranges in which the opposite "acid" and "basic" images are given. This seems to mean that the effect depends on the rapidity with which the different ions penetrate the tissues and this, in turn, must vary with the material used. Fixatives have usually been devised in the past by methods of trial and error. The methods of analysis used by Dr. Zirkle provide the means by which they may in the future be more systematically compounded, but the enormous diversity of materials used for cytological study warns us of the difficulty of any early generalizations.

COPPER SULPHATE AS AN ALGACIDE IN LAKES AND RESERVOIRS

Dr. G. W. Prescott
Assistant Professor of Biology, Albion College

Since lakes desirable for recreational purposes, and impounded waters for municipal use are frequently infested with objectionable algae considerable recognition is given to copper sulphate as a purifying agent. The effectiveness of copper sulphate as an algacide was demonstrated some twenty-five years ago by the work of Moore and Kellerman. Although widely used since its introduction but very little is known concerning the chemistry involved in the action of the salt and subsequently formed compounds with protoplasm. Furthermore, although many of the factors influencing the efficiency of the algacide have been determined, and although the specificity of certain organisms for different concentrations of copper have been worked out, a great deal of desired information is lacking. There are many physio-chemical and biological factors which should be considered in building an efficient program of treatment and these are not always properly recognized.

That there are significant variations in lakes treated for algae is shown when a comparison is made of the results in written reports of engineers who have employed copper sulphate in various parts of the country. In reviewing these reports on the effectiveness of copper sulphate it is at once obvious that required concentrations and methods of introduction may, and should, vary for different lakes. The differences in concentration necessary to adequately care for objectionable algae and the different degrees of success or failure in the use of copper sulphate when it is introduced according to usual recommendations emphasizes the point that each body of water must be studied and dealt with as a special case. That is, concentrations of the salt and methods of introducing which are efficient in one lake or reservoir may fail to give desired results in other, and, it may be, apparently similar lakes. Furthermore, different concentrations are required in the same lake at different seasons of the year.

Fortunately copper sulphate may be used in such dilute concentrations as an effective algacide that it is safe in water for human consumption and, if correctly introduced, is neither detrimental to most kinds of fish nor to fish-food organisms.

The need for considering the physio-chemical and biological conditions of a lake in formulating a treatment program has been emphasized to the writer by some investigations made during the past two years for the Iowa State Fish and Game Commission. Many of Iowa's otherwise very beautiful lakes have been almost ruined by superabundant growths of blue-green algae. One of the lakes has been given copper sulphate treatments so that an excellent opportunity has been afforded to compare conditions in treated and untreated bodies of water.

The factors to be considered in determining an efficient copper sulphate treatment for one of Iowa's lakes are as follows:

1. The kind, or kinds, of infesting algae. This is of course always fundamental since organisms are specific for various concentrations of the salt. The recommended concentration may or may not prove successful as determined by other important factors. It may be necessary to experiment with variations from the recommended concentration for treating a specific algal growth, and such is the case in the lake studied.

2. Temperature. The same organism will require a heavier concentration of the salt for its eradication in cold than in warm water. Hence in summer treatments (other factors not interfering) the necessary concentration is lower than in winter.

3. Suspended organic matter. Suspended organic debris interferes with the success of a treatment since these particles as well as living organisms take up the copper. Therefore, treatments may be more advantageously administered on calm days when the water is less roiled. Or it may be necessary to increase the recommended dosage for a lake which is persistently heavy in suspended matter.

4. Physical behavior of the infesting organisms. Since the more serious disturbers are of the so-called "water-bloom" type they may form great mats on the surface of the water. Many species normally are concentrated (at least during certain parts of the day) in the upper six inches of water. In treating for such forms it is obvious that a spray method rather than a drag method of introduction is likely to be more effective. In the drag method bags of copper sulphate are towed by boat. Surface organisms are not so efficiently dealt with as by the spray method. In the instance of Iowa lakes the infesting forms congregate at the surface in great 'patches' and

are carried across the lake by wind and current, finally heaping on beaches or in shallow water. This behavior means that an area of a lake recently treated with copper sulphate may, in a few hours, be infested with a great, putrefying mass of algae. Therefore a localized treatment of these 'patches' or 'banks' with a small boat, using either the spray or drag method is more efficient than giving the entire lake a general treatment, as is often recommended.

5. Alkalinity. The alkalinity of the water is thought to be highly responsible for the partial failure of the treatment of Iowa lakes. The lakes infested with blue-green algae all have a high pH value. In one lake it is as much as pH 9.6 in the summer period. By laboratory experiment it was demonstrated that an equal amount of copper sulphate in a series of known pH standards resulted in a distinct gradation in the amount of copper hydroxide percipitation. A pH of 6.0 showed but very little percipitate and this was very light and fluffy. From pH 7.0 to pH 9.6 there was a very marked ascending scale in respect to amounts of the percipitate. A tube of lake water was similarly treated in the series and the amount of percipitate formed in this tube was consistent with the pH of the sample. By laboratory culture experiments and subsequent chemical analyses for copper it was found that algae take up the copper hydroxide as well as any free copper. The fact that alkaline water causes a heavy percipitation of copper hydroxide does not mean that this directly interferes with the potential algacide action of the copper. It does mean, however, that since the percipitate is very heavy that nearly all, if not all, of the copper in an alkaline lake sinks rapidly to the bottom. Therefore, in a highly alkaline lake which is infested with a "water-bloom" organism the efficiency of the copper is manifestly interfered with, particularly if the drag method of introduction is used.

Further experimentation is necessary to learn whether or not or in what degree the concentration of copper sulphate used as an algacide in an alkaline lake behaves as do the high concentrations of the salt used in the laboratory experiments.

(This article is based on a seminar report presented at the Marine Biological Laboratory on August 2.)

MANGANESE AND THE GROWTH OF LEMNACEAE

Dr. Albert Saeger

National Research Fellow in Biology

Experiments concerned with the mineral nutrition of green plants have often given widely varying results. One factor that must be taken into account when synthetic nutrient solutions are used in nutrition work is the presence of small amounts of impurities that may occur in the chemicals used, in the distilled water, in the culture vessels themselves, or in dust settling from the air. The importance of minute traces of elements not usually added to nutrient solutions intentionally was pointed out by Mazé (1915) and by many since that time. At present it is believed that traces of Cu, Zn, Mn, Al, Si, B, As, Tl, I and perhaps others may play an essential part in the nutrition of green plants.

Hopkins (1930), growing pure cultures of *Chlorella,* showed that this alga was unable to grow in the absence of traces of manganese, and later he demonstrated the necessity of manganese for the growth of *Lemna minor.* Clark and Fly (1930), however, found no evidence that manganese was essential to the growth of *Spirodela polyrrhiza.* Since there was a possibility that there might be a specific difference in the manganese requirements of the Lemnaceae, five species were selected for experiments with manganese: *Spirodela polyrrhiza, S. oligorrhiza, Lemna minor, L. valdiviana,* and *L. minima.* They were grown in a solution containing Ca, K, Mg, nitrate, phosphate, sulphate, and a source of iron. The chemicals were purified by recrystallization and the water by redistillation. The cultures were transferred to fresh solutions twice a week. Constant temperature and illumination were maintained. The growth in controls without manganese was compared with that in solutions containing one milligram manganese per liter. All species growing in the solutions minus manganese developed typical deficiency symptoms (loss of roots, marked reduction in leaf area, appearance of necrotic areas on leaves) after from two to eight weeks, and finally growth in the minus manganese cultures ceased entirely. All species recovered when they were again transferred to a solution containing manganese.

It was found later that approximately 0.001 mg. manganese per liter solution (one part per billion) was sufficient to provide for vigorous growth of the species under the specified conditions. When such cultures were transferred to solutions minus manganese, typical deficiency symptoms appeared after about five days.

Traces of copper, zinc, aluminum, boron, iodine, and fluorine could not replace manganese in bringing about recovery from manganese deficiency.

Bottomley (1917-1920) had carried out a series of experiments with species of Lemnaceae (duckweeds)—*Spirodela* and *Lemna*—in which he showed that the addition of minute amounts of extracts of organic matter to an inorganic culture solution would result in a marked stimulation of growth. His conclusion that traces of organic matter (auximones) were essential in the nutrition of green plants could not be substantiated by later investigations (Mendiola, Clark and Roller, Saeger, Wolff). Extracts of organic matter may contain traces of various elements.

Manganese-deficient cultures of *Spirodela* will resume growth when manganese is again supplied. Cultures of *S. polyrrhiza* showing all the symptoms of manganese deficiency were used to detect the presence of manganese in aqueous extracts of spinach, digitalis, yeast, carrot, and Lemna. Each of the added extracts was able to bring about recovery of the manganese-deficient plants. The addition of the ash of some of the extracts also resulted in recovery. It is believed that the stimulating effect upon growth of green plants, observed when small amounts of plant extracts are added to a nutrient solution, may be due in part at least to the introduction of traces of essential elements into the culture solution. However, it is also evident that this does not entirely explain the marked stimulation observed. There must be other factors that are effective when such extracts are added.

The presence or absence of manganese and its concentration in natural waters is no doubt of importance in the distribution and the rate of multiplication of certain aquatic plants, including algal plankton. Uspenski (1927), in an extensive study of lakes and streams in Russia, has shown that the iron supply in these waters plays a decisive part in the distribution of algae. The relation of algal growth to manganese supply in natural waters awaits investigation.

THIS YEAR'S ECLIPSE OF THE SUN

James Stockley
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When the moon, in the course of its monthly circuits around the earth, passes between that body and the sun, producing a total solar eclipse, astronomers are always interested. And when the moon's shadow crosses a land area where there is a good chance of clear weather at the crucial moment, they do not hesitate to travel long distances in order to make the observations possible only at eclipse time. Thus, in October, 1930, two scientific groups, one from the U. S. Naval Observatory, the other from New Zealand, established themselves at Niuafoou, a nearly inaccessible little island in the Tonga group in the South Pacific Ocean. But total eclipses of the sun are not always visible only from remote parts of the world. In 1918 one was visible in the western United States, and many important observations were made. The year 1923 brought one to Southern California in September, but unfortunately the typically fine California weather failed to prevail. Few observations were made there, though astronomical parties in Mexico did have excellent conditions. When another eclipse track passed over New York, Connecticut, Rhode Island and Massachusetts early on the morning of January 24, 1925, the unexpected again happened, and the weather, along the eastern part of the track, was beautifully clear. An eclipse was visible along a path crossing England and the Scandinavian peninsula in June, 1927. Again, cloudy weather occurred over most of the track, but there were two notable exceptions. A German party in Lapland was favored with clear sky. In England, at Giggleswick, the point selected by the Astronomer Royal for the expedition of the British Royal Observatory, the day was almost completely cloudy, but a hole appeared in the clouds, surrounding the sun, just before totality. A few minutes afterwards it was raining.

With such interest shown in eclipses, it is not surprising that this year's eclipse, on Wednesday, August 31, has been eagerly awaited by astronomers, and by the general public as well, for many months. For the scientific fraternity, there is the added attraction in the United States of the meeting of the International Astronomical Union at Harvard immediately afterwards. This meeting would have been held last year, but was postponed to make it possible for foreign astronomers to combine it with the eclipse.

On August 31, according to the data published at the U. S. Naval Observatory by the Nautical Almanac Office, of which Professor James Robertson is in charge, the moon's tapering shadow first touches earth at 2:04.2 P. M., Eastern Standard Time (or 19h 4.2m G. C. T.) at a point in longitude 109° 16′ east of Greenwich and latitude 79° 36′ north. This is in the Arctic Ocean north of the East Taimir Peninsula. Thence the shadow travels northeastward and passes within a few hundred miles of the North Pole. As it then travels to the southeast, at an average speed of about two thousand miles an hour, it sweeps over Melville Sound, Prince of Wales Island; Boothia Peninsula, the District of Keewatin of the Canadian Northwest Territory, Hudson Bay, James Bay, the Province of Quebec and New England. Then it passes to sea and

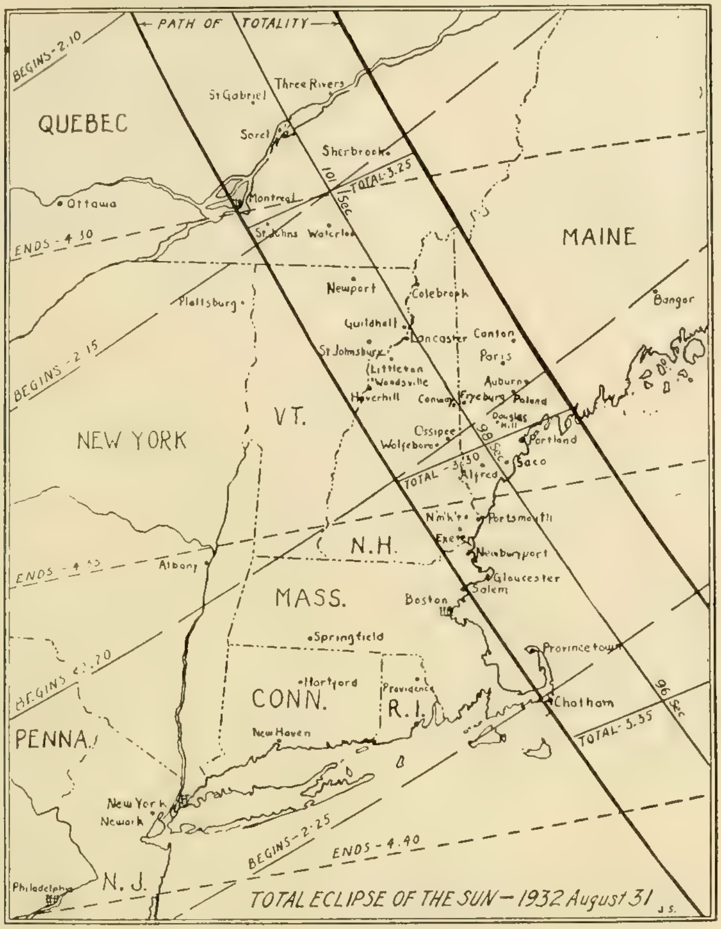

FIG. 1. PATH OF THE TOTAL ECLIPSE ON AUGUST 31, 1932.
The Eclipse will be seen as total from points within the two heavy parallel lines, and will last longest on the center line. The numbers on the center line show the duration of totality at that point and the solid lines crossing the path show the time of mid-totality. The long lines crossing the entire map show the times of beginning and ending of the partial phases. Traced from a map issued by the U. S. Nautical Almanac Office.

leaves the earth at 4:02.6 P. M., Eastern Standard Time (21h 2.6m G. C. T.) from a point in the middle of the Atlantic Oceaen with the coordinates of 40° 59′ west and 28° 27′ north, where the sun is then setting.

The path of the shadow in southern Quebec and New England is shown in detail in the accompanying map. Fig. 2 shows the shape of the shadow as it passes over this part of the earth. It is about 60 miles wide and a hundred miles long. In the middle of the eclipse track, where the widest part of the shadow crosses, the total eclipse will last about a hundred seconds. The lines crossing the shadow in Fig. 2, parallel to the edges of the path, are at ten-mile intervals and the numbers below indicate the time in seconds which that part of the shadow requires to pass a given point. It will be seen that, while longest duration is at the center, the total eclipse will last at least a minute over a band 80 miles wide.

To an observer in the path of totality, the first warning of the coming event will occur at about 2:20 P. M., Eastern Standard Time, for a point in New Hampshire or Maine. At that time, if the observer looks at the sun, with proper protection, he will see a slight nick in the right-hand edge. The best way to look at the sun is by means of a small telescope, but of course one should never look directly at it. If the telescope is set on a firm support, and pointed to the sun, a

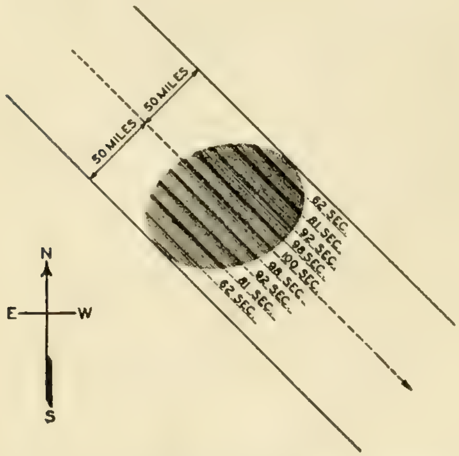

FIG. 2. MOON'S SHADOW WHEN CROSSING NEW ENGLAND
Reproduced from a Pamphlet Issued by the New England Hotel Association.

piece of white cardboard can be held a few inches from the eyepiece in such a way that a good image of the sun is obtained. Focus can be secured by adjusting the telescope eyepiece, or by altering the distance of the card. It is usually necessary to place another card, with a small hole in the center, around the telescope like a collar, in order to shield the screen from the direct rays of the sun. The sun can be viewed directly by the time-honored smoked glass, but better yet is a dense photographic negative.

The nick which appears in the right-hand edge of the sun at about 2:20 is the moon, which is now starting to come between the sun and the earth. Gradually the nick increases in size, as more and more of the solar disc is covered. Finally, the remaining part of the sun assumes the shape of a crescent, which continues to narrow. The sun's light assumes a peculiar yellowish color, because the bluish rays from the inner solar disc, ordinarily present in sunlight, are now eliminated. The spots of light under foliage, consisting of solar images made by the pinholes formed by the interstices between the leaves, are crescent-shaped, instead of round. Perhaps the shadow bands may appear. These are waves of light and shade which pass across light objects, like the white-washed side of a house, facing the sun. They are caused by streaks of varying density in the earth's atmosphere, and were very conspicuous in 1925 on the snow-covered ground. At some other eclipses they have hardly appeared at all.

Totality arrives, in New England, at about 3:30 P. M., as indicated on the map. If the observer has a clear view to some distance in the northwest, the moon's shadow can be seen approaching, like a tremendous storm-cloud, with awe-inspiring swiftness. At the same time, the last-vanishing sliver of the sun's crescent breaks up into a series of bright spots—the Baily's beads, caused by the sunlight shining through valleys on the limb of the moon, while adjacent lunar peaks already have passed the edge of the solar disc. The beads last only a moment, then, completely encircling the dark disc of the moon, now visible in its entirety, there flashes into view the magnificent corona of the sun, shining with a pale greenish light about half as brilliant as the full moon. The shape of the corona varies in step with the number of sunspots. As they are now at a minimum, the corona should probably have several long streamers, extending out from above the sun's equator to perhaps several times its diameter. From the poles there may emerge a series of brush-like rays of light. Close to the moon's disc there may be seen some of the red solar prominences, huge flames of hydrogen and other gases. Glancing around the sky, some of the brighter stars and planets can be seen. Jupiter shines brilliantly just to the right of the sun, and Regulus is just below. Still farther to the right is Mercury. These objects, and a few others, as they will appear at the time of the eclipse, are shown in Fig. 3, in a drawing prepared by Dr. J. J. Nassau, of the Warner and Swasey Observatory, Cleveland.

But not for long can one enjoy this spectacle of the total eclipse. About a minute and forty seconds after the corona made its appearance, its outer extensions begin to fade away, and the Baily's beads reappear, this time on the right-hand edge of the sun. The shadow is seen receding rapidly to the southeast. The Baily's beads coalesce to form a thin crescent of sunlight. Possibly, to a keen eye, the inner part of the corona may hang on for a moment or two after the sun has begun to emerge from the eclipse. The first reappearing bit of the sun, made larger by irradiation in the eyes, which have become dark-adapted during the eclipse, looks much larger than it is. Coupled with the continuous circle of the inner corona, the appearance is that of a diamond ring, the name coined for the effect when it was noticed by millions in 1925. Then the crescent of sunlight grows larger, as the moon moves off the solar disc to the left. Finally, at 4:34 P. M., the last nick on the sun's limb vanishes, and the eclipse of August 31, 1932, is over.

Not until 1963 will American astronomers again have the chance to observe a total eclipse with any probability of success. The next total eclipses of the sun visible at all in the United States are scheduled for July 9, 1945, and June 30, 1954, but these both begin in the northwest at sunrise and pass over into Canada a few minutes later.

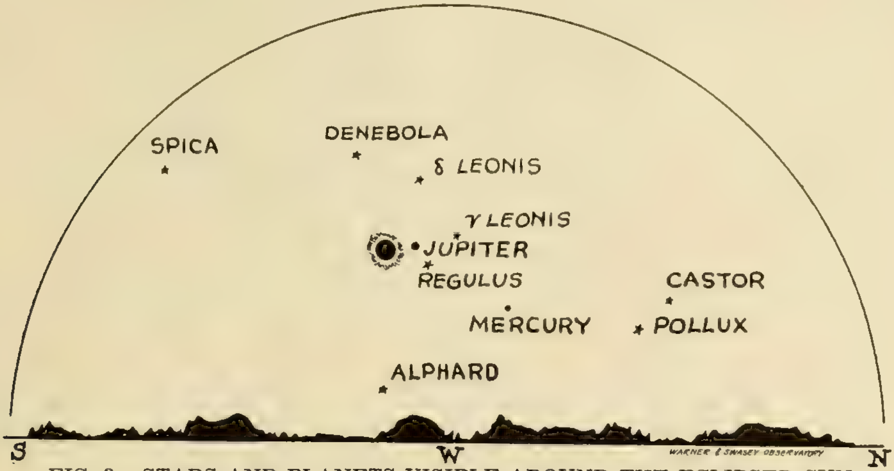

FIG. 3. STARS AND PLANETS VISIBLE AROUND THE ECLIPSED SUN ON AUGUST 31.

From a drawing prepared by Dr. J. J. Nassau, of the Warner and Swasey Observatory of the Case School of Applied Science.

On July 20, 1963, there will be an eclipse which almost duplicates the one of this year. It is visible over practically the same path, and lasts almost exactly the same time. Relying too implicitly on the approximate charts published in Oppolzer's famous "Canon der Finsternisse" (Vienna, 1887), astronomers have not generally realized that this eclipse would be visible in the United States. Like the one of this August, it is shown in Oppolzer's maps as passing through Nova Scotia, completely missing the United States. In his introduction, as Dr. A. C. D. Crommelin has pointed out (*Observatory*, Vol liii, p. 310), Oppolzer specifically states that the charts are merely approximate, as he has located the two ends and the middle of each track, and connected them with circular arcs, a figure quite different from the eclipse tracks. The data given in the tables in the same work show a track for this year's eclipse corresponding within a mile to that computed by the Nautical Almanac Office. Crommelin makes a plea, which the present writer seconds, that when speaking of the "path given in Oppolzer," astronomers should refer to the path computed from his data, and not that in the charts, unless specially designated. The true Oppolzer paths, for eclipses of the present century, are given by Mahler in the *Denkschriften der Akademie der Wissenschaften* (Vienna) Vol. 49.

After 1963, the next favorable American eclipse will be on March 7, 1970, in Florida. This will be followed by one on February 26, 1979, in the northwestern states along a line parallel to the Canadian border. Two others will come in 2017 and 2022, the latter passing close to New York City. The next eclipse of interest to astronomers, in any part of the world after this year, will be in 1934, when one will be seen from the South Pacific Ocean on February 14. Another will be seen from Japan in 1936, on June 19, and a very long one, lasting seven minutes, from another part of the South Pacific Ocean on June 8, 1937.

BOOK REVIEW

Recent Advances in Cytology, C. D. Darlington. P. Blakiston's Son & Co. xviii + 559. August, 1932.

"A vivid imagination is the first requisite for a good cytologist." Gene O'Mere

Darlington's book, "Recent Advances in Cytology," appears at an appropriate time. During the past few years, since Belling, Taylor, and Newton have shown that the smear technique used by the zoologists can be applied to plant material, the botanists have made great progress in cytological investigations. The recent cytological studies of taxonomic, genetic, and evolutionary problems have opened up a new field in biology. This work is summarized and reviewed by Darlington.

After reading Haldane's introduction, one might expect this book to be written in the manner of the Pope's "Encyclical"—an unequivocal message from God's representative on earth. But the first nine chapters show relatively little evidence of the Jehovah complex characteristic of some of Darlington's earlier publications.

Part 1 of this book deals with reproduction, mitosis, meiosis in diploids and polyploids, the evolution of polyploids, and the chromosome theory of heredity. These subjects are dealt with in a clear, concise, and comprehensive manner. The discussion of critical points is based on evidence obtained from many sources, as well as on Darlington's own extensive investigations.

The discussion of the function of the nucleolus might well have included Fikry's (J. Roy. *Mic. Soc.* 1930) theory that the nucleolus is a product of the chromosome and provides a mechanism for transferring gene products to the cytoplasm. In the second chapter we learn that each chromatid forms an independent coil or spiral in the meiotic chromosomes. The single coiled chromonemata described by Sakamura, Kaufmann, and others are attributed to optical illusions. It is to be hoped that some of these "optical illusions" will be demonstrated at the Genetics Congress at Ithaca.

Darlington also assumes that the chromosomes become longitudinally split during the resting stage, and not at the telephase stage, as is maintained by Robertson, Kaufmann, Sakamura, Kuwada, Sharp, and McClung. The assumption that the split occurs at the resting stage is essential for Darlington's theory of meiosis. The author does not permit a few facts to spoil a perfectly logical theory, so the contrary observations are thrown into the limbo of optical illusions.

The chapter on meiosis includes a detailed discussion of chiasma frequency and distribution in many different organisms. The various types of chromosome association in polyploids are also considered in relation to the principles of chromosome pairing. The description of meiosis in structural hybrids, in the following chapter, deals largely with the segmental interchange hypothesis, although Belling is not given credit for this theory.

The discussion of types of polyploids and their evolution is very clear and comprehensive. The reputed autopolyploid nature of Pyrus is probably incorrect, and the classification of some other genera may be questioned. The chromosome theory of heredity is considered briefly.

The tabular summaries of types of chromosomes, chiasma formation, segmental interchange, chromosome pairing, and the origin of different kinds of polyploids will be useful to both students and investigators.

The second part of the book deals with the mechanism of crossing over, the precocity theory of meiosis, the mechanics of chromosome behavior, the cytology and genetics of sex differentiation, mutation, apomixis, and the evolution of genetic systems. Here Darlington is at his best. Hampered by a minimum of annoying facts, his imagination is free to develop numerous theories and hypotheses, many of which are perfectly logical. But, as has been clearly demonstrated, some of Darlington's perfectly logical theories are completely erroneous. Nevertheless, this section of the book contains many valuable suggestions, and is well worth reading.

The "partial chiasmatypy" theory of Jannsens is considered as the correct interpretation of crossing over. Each chiasma represents a crossover which occurred at pachytene, and only pairs of sister chromatids open out together at diplotene. As soon as the resulting chiasmata are formed, they may move along the chromosome so that, in certain regions of the bivalent, non-sister chromatids are paired. Both Jannsens and McClung have shown that such an origin of the chiasmata should produce an asymmetrical relation of the chromatids at or near each chiasma. McClung has pointed out that, in most cases, the chromatid relations are symmetrical, as would be expected on the "classical theory" of chiasma formation. This evidence is ignored by Darlington, and most of the chiasmata represented in his diagram show a symmetrical arrangement of the chromatids. Some of the relationships of chromatids shown in the diagrams (Fig. 58 A1) are impossible.

According to Darlington's theory, chromosome pairing at meiosis is dependent on chiasma formation, so that no chromosome can have a crossover length of less than 50 units. The geneticist will be surprised to learn that the fourth chromosome of Drosophila may be 50 units long. We are also told that in attached X chromosomes of Drosophila, factors situated more than 50 units from the spindle fiber should be freely assorted as between chromatids, and that Rhoades' data mean "most probably that a disproportionately high amount of crossing over occurs between chromatids continuing one another, and therefore passing to the same pole." Both statements are erroneous, as are several other references to Drosophila genetics (p. 396). The absence of crossing over in the chromosomes of the Drosophila male is not explained.

The theory that crossing over follows chiasma formation, by breaks in some of the chiasmata, is rejected for "five chief reasons," none of which are critical. The fifth reason is based on an assumption so obviously invalid that it seems incredible that Darlington could have considered it seriously. Belling's theory of the mechanism of crossing over—which is certainly the most plausible explanation if the partial chiasmatypy hypothesis is correct—is not considered seriously by

Darlington, and instead the older torsion hypothesis is revived. It is significant that no diagrams are included to show how crossing over might occur, on this hypothesis; why the breaks are so exact; and why only two chromatids cross over at any one locus. Darlington's imagination was evidently below par when this discussion was written.

The chapter on the theory of meiosis is brief. The dead body of the telosynapsis theory is buried with little reverence. The precocity theory of meiosis is developed and is based on the assumption that at meiosis the chromosomes entering the prophase stage are single and not double, as they are in somatic divisions. The theory is perfectly logical, regardless of its validity.

Considerable space is devoted to terminalisation of chiasmata. It is shown that, in many genera, from two to six interstitial chiasmata are found at diplotene, but at metaphase only one or two terminal chiasmata remain. The interstitial chiasmata are assumed to move towards the distal end or ends of the chromosome without passing off the ends of the bivalent. If crossing over is at random between chromatids, it is difficult to reconcile this theory with the types of terminal chiasmata actually observed, but Darlington does not discuss this problem. A change in homology of chromosome segments may arrest terminalisation. "Terminal affinity" prevents the chiasmata from sliding off the ends of the bivalent before anaphase.

An interesting discussion of abnormalities in meiosis is presented in connection with the author's theory of meiosis.

The behavior of sex chromosomes and the inheritance of ring-formation are discussed under the heading of permanent diploid hybrids. Several of the assumptions regarding the constitution of chromosome rings in Oenothera are unlikely to be supported by recent investigations, although Belling's segmental interchange theory is sound enough. The discussion of sex heterozygotes is good.

The last chapter is written in the manner one might expect after reading Haldane's introduction. Starting with four apparently sound hypotheses, a perfectly logical theory is developed which explains evolution, the origin and development of the sexual cycle, and the fundamental cause of variation in organisms.

The theory is very simple. The original living particle was a "naked gene" which had the property of division to form many genes. Mutation produced new genes. The genes became arranged in a linear order by the formation of a single chromosome. When this chromosome became too long to divide regularly, it broke up into several chromosomes. The length of the chromosomes is also reduced by "a spiral produced by a state of torsion between the spindle fiber and the chromosome envelope."

The fusion of two simple organisms would produce a diploid form. Precocity of the prophase stage of division initiates meiosis. Crossing over invariably occurs at meiosis, resulting in an association of homologous chromosomes by chiasmata. This system is of evolutionary importance because it provides for recombination of genes and structural changes. But this advantage is restricted to hybrids,—"hence the countless physiological and mechanical devices which have been developed to promote hybridity wherever meiosis occurs." Meiosis is restricted in time and space to permit the development of the diplophase. Localisation and terminalisation of chiasmata permit regular chromosome disjunction.

Differentiation of fusing cells is caused by genetic changes in two directions. In the case of diploid differentiation, one of the two kinds of diploids must be heterozygous. One diploid system is kept in a permanent heterozygous condition by suppressing crossing over between the affected differences,—i. e., between the sex chromosomes. Thus the sex chromosomes lose all qualitative relationship, and later all quantitative relationship. Since the Y chromosome does not reproduce itself in the homozygous condition, it will lapse into unimportance and may often be eliminated.

Hybridity is stabilized by apomixis and by segmental interchange of chromosomes.

In lower organisms variation is dependent on gene mutation, but in higher organisms where meiosis and hybridisation occur, two other factors are of more importance. These are structural or numerical changes, induced by irregularities in meiosis, and changes in proportions of genes conditioned by hybridisation.

This concluding chapter is a masterpiece, and the simple and orderly development of the theories involved is most ingenious. According to Gene O'Mere's standards, Darlington must be rated as the world's greatest cytologist.

Before concluding this review, I wish to quote two sentences from Darlington's book. The first is a quotation from Bacon, found in the Appendix. "The method of discovery and proof according to which the most general principles are first established, and then intermediate axioms are tried and proved by them, is the parent of error and the curse of all science." The second sentence is from Haldane's description of Darlington's method of investigation. "As his colleague I can testify that he has investigated an apparently most heterogeneous series of plants with a very clear idea of what he was looking for in each case, and that on more than half of these occasions he found it."

Arnold Arboretum —*Karl Sax*
Harvard University.

THE PUBLIC MEETING ON THE BEACH QUESTION

(NOTE: The report of the meeting given below is based upon stenographic notes. In some cases the complete statements were not recorded; in many cases it is not unlikely that the wording reproduced below has been altered somewhat from the actual words used by the speakers. The brief interval (elapsing between the time of the meeting and the time the compositor required the material) did not permit us to submit the statements that we obtained to the many speakers for correction.)

On Thursday evening a public meeting was held in the Old Lecture Hall of the Marine Biological Laboratory to find some method of relieving the congestion now prevalent on the Bay Shore bathing beach. About one hundred people were actually present, although this number was greatly increased by the many individuals outside who assembled around the windows of the Hall.

The meeting was called to order by its chairman, Professor Caswell Grave, shortly after eight o'clock, who introduced the subject.

Dr. Grave: "We have been called together to discuss the Woods Hole Beach Problem. The problem dates from 1928 when the Fay Estate deeded to those who make Woods Hole their home the beach rights on Lot (X). That called attention immediately to the fact that a great many people who thought hitherto that they had beach rights were mistaken. Until that deed was made Woods Hole had no beach rights, although they had, since the community was founded, used the Bay Shore as a bathing beach and assumed that they were simply using the rights that belonged to them. Members of the Marine Biological Laboratory had no real beach rights—it was only by tolerance of those who owned the land that they were able to use the beach. Thus it began. As time goes on and as shore property is taken up for various purposes, beach privileges are being withdrawn. The Laboratory, having no beach rights, is indebted to the kindness of Dr. Strong who bought the lot next to "X" so that laboratory members might have the rights of residents. Lots (1) to (5) are now improved and owners of property on these lots exercise their very proper rights in seeing that these belong exclusively to them—no one has beach privileges on their lots. This has been the situation since 1928. There has been agitation of the matter ever since. At the time Dr. Meigs bought "Lot X" it was attempted to have some sort of organization to raise money and develop it. Nothing came of that. At its annual meeting in 1930 the Woods Hole Protective Association was asked whether it would assume some sort of responsibility. It decided, however, not to extend its responsibilities to include this problem. Those who were interested stayed in the room after the meeting had adjourned to consider the beach problem. They authorized a committee to be formed; there was no other authorization other than this informal group. This committee had conferences with lot owners. It was suggested that if a satisfactory patrol could be organized the lot owners would withdraw their restrictions, at least until they saw how this proposition worked out. Next year conditions were different and the lot owners had changed their minds, so nothing came of this effort.

"A similar unauthorized committee was formed last year that decided to present the question to the Marine Biological Laboratory and ask it to assume responsibility for the beach. The Laboratory, however, preferred to have nothing to do, officially, with the beach question.

"This year those who had been responsible for presenting the subject to the M. B. L. came together again to consider what next should be done to solve the problem."

The secretary, Dr. E. R. Clark, was asked to read such portions of the minutes of the initial meeting as he believed desirable. THE COLLECTING NET printed an account of this meeting in its number for July 30, and therefore the report will not be duplicated here.

The four plans drawn up by the sub-committee were next presented by Professor H. B. Goodrich as follows:

PLAN NO. 1.

All things considered, such as the paucity of long sandy beaches in Woods Hole, the encouragement of rapid growth of the summer population, the desirability of avoiding great overcrowding at the beach, it seems that there is cause for congratulation that there is an easily accessible bathing beach, the use of which and the right of way to which have been deeded to and accepted by the town, in perpetuity, and that this beach, under private management, has been so excellently conducted that all minor difficulties have been greatly outweighed by the many major advantages. Let us acknowledge the debt which we owe first to the Fay Estate and more recently to Dr. and Mrs. Meigs.

It is not by any means a certainty that a radical change in mangement will result in an improvement of the situation.

There is, however, one matter which is surely beyond the province of Dr. and Mrs. Meigs to regulate, namely, the rocky condition of the beach between high and low water. There is apparently a very strong probability that a jetty, built out from the shore, would permit the sand to settle over the stones and provide a completely sandy beach fronting lot X—the bathing beach lot. The construction of such a jetty would seem to be properly a town function, and it is therefore recommended that the town be asked to examine into the matter and to appropriate funds for the construction of such a jetty—if necessary obtaining an enabling act from the State Legislature to legalize the procedure. Should such a jetty provide a completely sandy beach for the entire 231' fronting lot X, one of the chief disadvantages of the beach would be met.

To assist Dr. and Mrs. Meigs in handling other

(Continued on the Log: pages 210, 212, 214 and 216.)

THE BAY SHORE BATHING BEACH
Above: Looking Southwest over the "Private" Beach.
Below: Looking Northeast over the "Beach" on "Lot X."

The Collecting Net

A weekly publication devoted to the scientific work at Woods Hole.

WOODS HOLE, MASS.

Ware Cattell .... Editor

Assistant Editors

Annaleida S. Cattell Vera Warbasse

Contributing Editor to Woods Hole Log

T. C. Wyman

Salesmen at the Laboratory

Recently a professor of biology who is working at the Marine Biological Laboratory, remarked that efforts should be made to prevent salesmen from disturbing investigators in their research rooms. He said that two persistent individuals had taken much of his time one day that week. If some reasonable regulation could be enforced it would be appreciated by many members of the Laboratory.

There are a great many young research workers at the Laboratory who would value greatly a half-hour's conference with a senior investigator. However, they naturally refrain from consulting their superiors whom they often have not met. A salesman is not so tactful. We believe that investigators would find it more stimulating to talk to an active graduate student about his research problem, than trying to be polite to an eloquent salesman. Furthermore, after the interview was ended he would have a feeling of having made a contribution to biological research instead of having forwarded the interests of a commercial firm.

Placing the Old Lecture Hall (for which no charge is made) at the disposal of manufacturers of scientific apparatus was a wise move. Investigators can look over their products at their convenience, and we would willingly wager that the average investigator is in a more receptive frame of mind to listen to the merits of products there, than in his research room where he may be immersed in some important experiment. Any salesman of merit should be assigned a place in the Old Lecture Hall—none should be allowed to pedal their wares from room to room.

THE CONCERT OF THE CHORAL SOCIETY

The sixth annual concert of the Woods Hole Choral Society takes place in the Auditorium of the Marine Biological Laboratory on Monday night, August 15th at eight o'clock. Admission will be fifty cents and a dollar. The Choral Society was organized in 1927 to give an opportunity for serious part-singing to those investigators, students and members of the community who were fond of the art. Its director has been Dr. Ivan Gorokhoff, leader of the Glee Club and choirs of Smith College. Professor Gorokhoff has introduced the Society to some of the wealth of musical literature for which the Russian Church is so famous, and to a few of the boistrous peasant-songs of the old Russia. This year's repertoire also includes one chorus from Alexander Borodin's opera, "Prince Igor." Borodin, best known for his short list of musical compositions, was originally a chemist and a medical man. As in other years, the program has been balanced by the inclusion of old English part-songs and choral works of Handel and Palestrina.

The officers of the Choral Society this year have been Dr. E. R. Clark, President; Dr. Charles Packard, Secretary-Treasurer; Miss Lois Te Winkel, Librarian; Mrs. Bess Kaliss, Accompanist; and Prof. Gorokhoff, Director. Over fifty people are members of the Choral Society. After the concert, the Society will continue meeting twice a week for the rest of the season, to learn new music. Anyone wishing to join the chorus is invited to consult Dr. Gorokhoff. The rehearsals are held on Tuesday and Friday nights after the lectures are over, in the M. B. L. Club House. —*W. B.*

The Program for the Concert is as follows:

1. Hellelujah, Amen (from "Judas Maccabaeus") *Handel*
2. Hymn to the Mother of God *Tschaikowsky*
3. Psalm 148 *Gustav Holst*
4. Ave Maria *Palestrina*
5. God is With Us *Kastalsky*
6. The Day of Judgment *Arkhangelsky*

Intermission.

7. Chorus of Villagers *A. Borodin*
8. Wassail Song *Vaughn Williams*
9. My Bonnie Lass She Smileth *Edward German*
10. Spinning-Top *Rimsky-Korsakoff*
11. The Gypsy *Zolotarieff*

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
Aug. 13	2:14	2:24
Aug. 14	3:11	3:21
Aug. 15	4:03	4:13
Aug. 16	4:50	5:02
Aug. 17	5:34	5:49
Aug. 18	6:16	6:33
Aug. 19	6:57	7:17
Aug. 20	7:38	8:02
Aug. 21	8:21	8:47

The average speed of the current in the hole at maximum is five knots per hour.

ITEMS OF INTEREST

Dr. C. D. Darlington of the John Innes Horticultural Institution, London, was married recently to Miss Kate Pinsdorf who is instructor in history at Vassar College. The ceremony took place at Hyannis, Massachusetts, in the presence of a few friends.

Dr. Honor B. Fell, Director of the Strangeways Research Laboratory, Cambridge, England, has been visiting Dr. and Mrs. Chambers for the past week. She will visit the Storrs Agricultural Station for a few days before attending the Genetics Congress at Ithaca.

Mr. Ellis M. Lewis gave us the following note on Thursday for publication: "*Article*: To see what action the Town will take to acquire a bathing beach in the Village of Woods Hole, for the Residents of the Town and their Guests, also the tax payers; that the Selectmen hold a public hearing in the Village of Woods Hole, for the benefit of all Tax payers, on this matter, said hearing to be held within fourteen days from date of this said meeting; the Selectmen to report their doings at the next Annual Town meeting.

—*Park Commissioner.*

In one of our last numbers we expect to have the privilege of printing the lecture entitled "Regulations of Ions in the Body Tissues" which Dr. Rudolph Mond recently presented at the Laboratory. It was recorded in shorthand by a stenographer, and Dr. Mond planned to re-write the typewritten copy on the boat and mail it to us from Hamburg.

Dr. Abraham White has been appointed Porter Fellow for the year 1932-33 by the council of the American Physiological Society.

Last Sunday due to the bad weather the Penzance Forum was held indoors. Roger Baldwin, Director of the Civil Liberties Union spoke on the subject, "Is America Headed for Fascism?" Mr. Baldwin said that all the tendencies in the United States were pointing towards Fascism. Mussolini has contributed one thing to political science — the combination of the economic and political interests into one system. This dictator is master of italian finance and business as well as of politics. The government in America really is not in Washington but in Wall Street. Mencken proposed J. P. Morgan as the most logical candidate for president. The speaker concluded that the fascism to which America will arrive will be a dictatorship by the business classes. —*V. W.*

THE EDWIN S. LINTON MEMORIAL ENDOWMENT FUND

Few people realize that there is an Edwin S. Linton Memorial Endowment Fund of $2,500 which provides a scholarship for a student or investigator from Washington and Jefferson College to work at the Marine Biological Laboratory each summer. The sum of approximately $125.00 is available for this purpose each year. This Spring it was awarded to Mr. C. D. Dieter who has been associated with the college for eleven years. He is now assistant professor of biology at this institution. Mr. Dieter took a course at the Laboratory and he is remaining to continue his work in fish embryology. He is especially interested in the behavior of chromatophores in oviparous fish.

Dr. Linton was made emeritus professor of biology and zoology at Washington and Jefferson College in 1920. His son, for whom the endowment is a memorial took the course in invertebrate zoology and physiology at the Marine Biological Laboratory about fifteen years ago.

A son, weighing nine and a half pounds, was born to Dr. and Mrs. Lester G. Barth on August 11, in Cambridge.

Between ten and twelve flounders, all of good size, were caught off the steamboat dock last week. Robert Leighton caught the prize fish when he hauled an 8½ pound flounder out of the water. —*T. C. W.*

In a recent number of *Science* (July 29) E. Harold Hinman announces the presence of microorganisms within the eggs of mosquitos. In a limited number of cases he has been able to isolate gram negative and gram positive bacilli, staphylococci and yeast from the ova of *Aedes aegypti*. In checking his discovery Mr. Hinman used both bacteriological and histological methods. In the concluding paragraph of the article he writes:

"The possibility of hereditary transmission of the etiological agent of either yellow fever of dengue through the mosquito host is of great epidemiological importance. To date experimental work along these lines has been negative, with a single doubtful exception. Yet if viable bacteria may occasionally be recovered from the ova of *Aedes aegypti* one might expect that the virus of either yellow fever or dengue would, under certain circumstances, appear in the eggs of infected females."

NEWS FROM OTHER BIOLOGICAL STATIONS

SCRIPPS INSTITUTION OF OCEANOGRAPHY

(Received July 30)

Dr. Ray Carpenter of the Yerkes Laboratory at Yale University visited the Institution this week. Dr. Carpenter is doing research work on the psychology of primates and, as a holder of the National Research Council Fellowship in that field, has been studying the primates (mainly monkeys) of New World type in Central America. In these studies he has given special attention to play and to other social habits. On Monday evening he gave a brief report on the results of his observations.

(Received August 8)

Prof. H. S. Jennings of the Department of Zoology in Johns Hopkins University, noted for his pioneer work on "psychology" and conditions of behavior of lower organisms (mostly microscopic) visited the Institution at the middle of last week. More than twenty years ago he spent a summer at the old laboratory at La Jolla Cove and performed his interesting experiments on behavior of one of the local starfishes.

On Monday evening of this week, Prof. A. E. Douglas of the Department of Astronomy of the University of Arizona delivered a lecture on tree rings and their relation to climatic and solar cycles and to human history.

Another visitor was Dr. H. C. Bulger of the Department of Medicine of Washington University Medical School of St. Louis, Mo., who visited the Institution on Friday of last week.

Dr. Graham Marks, recently of Stanford University, arrived on Monday of this week to serve as assistant to Dr. D. L. Fox in physiology for the rest of the academic year.

Dr. and Mrs. H. R. Byers arrived at the first of this week to spend the rest of the academic year at the institution. Dr. Byers is to act as research assistant in meteorology under Dr. C. F. McEwen.

Dr. C. B. E. Douglas, a mineralogist of Old Mexico, visited the Institution at the end of last week.

Mr. D. W. Gravell returned to Houston, Texas, this week where he is employed by the Gulf Production Company. He has spent several days at the Institution recently making certain special studies on foraminifera.

NOTES FROM CORNELL UNIVERSITY

Professor J. C. Faure of the University of Pretoria, South Africa, is completing at Cornell and at Minnesota his remarkable studies on migratory locusts. He has proved that the long winged, migratory locusts (*Melanoplus spretus*) famous for their ravages and the shorter winged, non-migratory, solitary species (*M. atlantis*) hitherto generally considered distinct are one and the same species. He has produced a migratory form from eggs of the non-migratory one by crowding. When crowded they continually agitate each other to muscular activity and they grow longer wings and darker colors, and take on all the other differences hitherto considered to be specific. He has shown that the differences between the two forms result from differences in activity during development. Professor Faure has reared from the eggs of the migratory long-winged form the non-migratory, short winged one by keeping them isolated. Nymphs of the short-winged form without any crowding but with continual agitation have been made to develop the long wings and all the other characters of the migratory form. Thus he has demonstrated that the activity of a species during development may determine the presence of characters hitherto considered specific.

Mr. A. L. Brody is working on the transfer of fowl pox by mosquitoes.

Mr. W. J. Van der Linde is working on the Nematodes that affect root crops in muck soil.

Mr. William O. Sadler is completing a series of studies on the production of blood worms (larvae of Chironomus) for fish food.

Mr. O. R. Kingsbury is studying the hatchery diseases of fishes.

Dr. J. R. Traver and Professor J. G. Needham are working jointly upon a monograph of North American mayflies.

THE MOUNT DESERT ISLAND BIOLOGICAL STATION

Miss Miriam Slack and Miss Margaret Lewis gave a picnic on the shore for the young people, on July 26th. Mr. Gordon Spence brought his aquaplane and a few of the Laboratory boys entertained the group by their surf-riding. Tennis, cricket, quoits, sailing, bridge and dancing completed a happy program, music for the dancing being furnished by the famous Slack orchestra.

WOODS HOLE LOG

minor difficulties even to the extent of eventually relieving them, if they so desire, of the burden of maintaining the bath-house lot, it is recommended that a Woods Hole Bathing Beach Society be organized, which shall have annual dues, the income from which shall be used to maintain the raft, keep the beach clean and orderly, and perhaps provide a lifeguard at certain hours—all this in cooperation with Dr. and Mrs. Meigs. It is suggested that such a Committee start the raising of funds for future needs.

Regarding the seventy feet of beach facing Lot 6, which is owned by Dr. Oliver Strong, and to which he allows free access for bathers, it is suggested that we express to him our gratitude and appreciation for his far-sightedness and generosity.

Unless Dr. Strong wishes to dispose of his property it would seem an act of ingratitude to force him to relinquish it. It would be well, however, for the Beach Society, if formed, to obtain the refusal of at least the riparian rights, in case he should at any time decide to sell.

As for the beach fronting lots 1-5, it is believed that the 321' now available will be adequate, if the entire extent becomes a sandy beach, following the erection of the jetty. The property owners who have built cottages on these lots permitted the public free use of their property—which extends to the water's edge—for many years, and for this privilege we should express our hearty thanks. They were entirely within their rights according to the interpretation of the laws of Massachusetts in barring the public, which they did only after they had been subjected to disturbances, inconveniences and, at times, insults, which eventually became unendurable. For these we should express our sincere regrets. It is hoped that the action taken in the future may eliminate the objectionable features to such an extent that at least some restricted access may be granted.

ELIOT R. CLARK,
July 30, 1932.

PLAN NO. 2

That the Town of Falmouth at its next regular meeting be requested to take such steps as may be necessary to acquire possession of lots "X" and "6"; to appropriate such sums of money as may be required to so improve the beach on these lots that its entire extent is made suitable for the legitimate and usual purposes of a bathing beach; these improvements to include the construction of a jetty, the removal of stones from the beach and moving the bath house to a more suitable and convenient location on lot (X) and that this beach be legally reserved for the exclusive use of the permanent and Summer residents of the Town of Falmouth.

PLAN 3.

That the Town of Falmouth at its next regular meeting be requested to take the steps ncssary to necessary to acquire possession of lot "X" in entirety including the bath house, and a strip of beach on lots 3 to 6 from low water mark to the stone wall (extended) now standing and that this beach be legally reserved for the exclusive use of permanent and Summer residents of the Town of Falmouth.

PLAN 4.

That the Town of Falmouth at its next regular meeting be required to take the steps necessary to acquire a strip of beach on lots 3 to 6 inclusive included between low water mark and the wall now standing, thus adding about 280 feet of beach to the 231 feet on lot "X" deeded by the Fay Estate to those who make Woods Hole their home and that this beach be reserved for the exclusive use of the permanent and Summer residents of the Town of Falmouth.

In commenting on them Dr. Goodrich said that, "Plans (1) and (2) differ in that one concerns private, the other public control. Plans (3) and (4) make available a wider strip of beach than at present—three lots to be added to that now available, without a jetty. They differ from each other in that No. 4 is probably the least expensive in that lot "X" is not to be acquired, just certain extensions to it as desired. All plans contemplate restriction on the beach."

Dr. Grave: "You now have before you the four plans. Before they are discussed, I should like to state something further about the action of the committee, since the question may naturally come up as to whether we had considered certain other beaches, that is, why has the committee made plans concerning only the Bay Shore lots? It has considered all other possibilities brought to its attention. The Murray Crane beach has been pointed out as a good one, but it is too shallow, too sluggish, possibly open to contamination by sewage, and it is not especially accessible, furthermore, the beach would then be divided. The Nobska beach was considered;—objections are that the water is very definitely colder than that on the Bay Shore; it is too deep for children and is therefore dangerous; subject to accumulation of debris; too inaccessible to people without cars. The beach near Gansett is too inaccessible to persons working at the Laboratory or living near it. Another reason why the committee has turned naturally toward the Bay Shore is that it is the beach to which residents, both permanent and temporary, have resorted since people first began coming to Woods Hole—it is *the* place where the people of Woods Hole desire a bathing beach.

"The whole proposition is: which of these plans settles the question in a satisfactory way; what is meant by an "adequate" beach for Woods Hole. Do plans (1) and (2) give a beach of sufficient area to settle the question for the future?

"The question is now open for discussion."

Dr. Bigelow: "As one of the oldest members of the group here, I think that I know something about the use of the beach. I should like to make somewhat of a substitute to what has been said. It is true that this beach has always been used by the people of Woods Hole—probably since the time of the aborigines. It was a satisfactory beach then—it is a satisfactory beach now. It would be perfectly adequate now if it were not restricted. For a long time people always had access to this beach; then a subdivision was made and people

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acquired property rights on the beach. They became annoyed by persons who were noisy or offensive in other ways. That, however, could be avoided. I propose the following: that the Town of Falmouth be requested to police the beach properly with one of their uniformed policemen, who would appear at unexpected intervals to see that everything is in order, on the condition that the fence be removed. I should like to substitute this for the other four plans and I move that the Town of Falmouth take over this beach, patroling that previously restricted."

The objection was made that such a police officer on private property could not be paid with public money.

There was no second to this motion.

Mr. Larkin: "I believe that the town is entitled to have more beach. I can truthfully say that I never realized until recently what a terrible beach we do have. I was down there only last week and found people jammed up against the fence—sixty people in that vicinity and probably that many more in the water. Children playing quietly on the other side of the fence have been ordered off. Plan (4) would obviate a lot of expense—improvement of the frontage on Lot X could be carried out whenever there is money enough. Lot X itself is not large enough. I therefore move that plan (4) be recommended by this meeting."

The motion was seconded by Mr. Forrest Boynton and the question was opened for discussion.

Mr. Compton: "I want to know whether anyone had considered the possible cost of any of these plans—since a warrant could not be brought before the town without a specific proposal."

Dr. Grave: "A committee to be appointed by this meeting would draft such an article including cost—which would probably depend on the value of the beach rights. The relative costs of the four plans as very roughly estimated were: (1) $8,000; (2) $20,000-25,000; (3) $16,000; (4) $8,000. The estimate of plan (4) was based on the value of the beach rights of the four lots."

Mr. Griffin: "The estimated cost of the jetty is based upon the cost of the one built at Falmouth Heights which cost $8,000 and extends 100-150 feet into deep water. This is only a rough guess —the cost of building jetties may be over $50-000."

Mr. Lewis: "The Town's part in paying for the jetty was $4,495—the state paid the rest. This was some years ago—it would probably be much cheaper now."

Dr. Miegs: "I am opposed to plan (4). As the situation is at present the owners of the beaches, the residents of Woods Hole, and practically, also, all the Laboratory people have the privilege of bathing in front of lot X and Dr. Strong's lot. Plan (4) proposes that the beach be extended 50 per cent. but at the same time the whole Town of Falmouth be given the privilege of bathing there. We complain that the beach is over-crowded. Increasing the beach by 50 per cent. and extending bathing privileges to Falmouth and possibly the whole State of Massachusetts would get us nowhere. If such a plan were carried through, residents and laboratory people would find themselves in the position of the dog who dropped a bone he had in his mouth to pick up the reflection of it he saw in the water."

Dr. Grave: "Inasmuch as it is definitely stated in plan (4) that no improvements are contemplated, there seems to be no danger that people throughout the State of Massachusetts would use this beach if they could find any other."

Dr. Clark: "I believe that plan (4) is the most radical of any that have been proposed. If the beach were improved so that we had a good sandy stretch, that is, the three hundred feet that we now have, since Dr. Strong permits free access to his lot, would be adequate. It is not at all unlikely that with a jetty the sand would increase not only the width but the depth of the beach. It might be feasible, therefore, instead of starting this thing which has a good many things tied up in it, to try something else first and see how it works out. As far as jetties are concerned—it would be possible to collect $500—there have been offers of money already—to put up an experimental jetty, say to fifty feet, bringing it up to the level of the water between "Lot X" and just west. Leave this for a couple of years and see whether it does not give a good sandy beach—without causing any ruption or disturbance—this is a friendly community and we all want to get along without any unpleasantness. Three hundred feet is about as much as the public actually owns in Falmouth. It would be entirely possible to put out an experimental jetty—if that worked it could be extended another fifty feet. It is possible to obtain from the Bureau of Harbors permission to build a jetty as far out as 250 feet, so that in five years, building fifty feet a year, the jetty would be completed. This could easily be arranged by a committee in cooperation with Dr. and Mrs. Meigs. There are some who feel quite guilty in making use of these lots for bathing without contributing toward them, and who would be quite willing to contribute a certain amount for this purpose. It would all be taken care of by getting Lot X and Dr. Strong's lot and have a jetty so that it would grow in depth as well as width. I should like to see the proposition voted on by a rising vote—starting with (4) and working back

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if that is desired—and see exactly how many are in favor of any one plan. The clause concerning ownership and control by "the Town of Falmouth" in proposition No. 1 would be revised. Probably it would take a number of years for them to get going, so that it seems a wiser scheme to start working with private funds right now."

Dr. Baitsell: "I should like to bring out two points: (1) that the procedure of voting as decided upon is correct; that is, voting first on plan (4), and if this is rejected the other plans can be taken up.

"I don't agree with Dr. Clark when he says that plan (4) is the radical plan, and plan (1) the simple, friendly way out. I believe, on the contrary, that plan (4) more nearly insures friendliness and contentment to the several hundred residents of Woods Hole than plan (1) which would benefit directly only a few families."

Dr. Strong: "The town of Falmouth has not evidenced any desire to bathe here. It might be possible to work on something on the order of plan (1). There is a practical objection in raising money and in the time necessary in the carrying out of such a plan. Some other plan could be substituted in the meantime—such as dumping sand to cover the stones which could be done right away.

"I would like to know who owns the tennis lots. If these are taken out under the name of the Laboratory, such ownership, as I understand it, would give everyone working there the right to use lot X."

Dr. Hill: "The beach courts belong to the Tennis Club, and not to the Laboratory."

Dr. Goodrich: "In discussing these schemes we might weigh the merits of private against public control. I'd like to speak in regard to private ownership. I am doubtful of the value of that plan. We have already experimented twice in a minor sort of way with private ownership and it has not been successful. An attempt by Dr. Meigs some years ago to make a private arrangement failed, and the Woods Hole Protective Association also failed. In connection with the Laboratory it could be pointed out that other private organizations have succeeded, but these cases have been relatively simple matters, The M. B. L. Club has not been altogether successful—it is difficult for such an informal organization representing such a transient group to function satisfactorily. Even now the raft is not wholly paid for. This sort of affair which is expensive needs an even better organized group. There are difficulties in the way of private control. It is doubtful how easy it would be to raise money. As for the matter of trying out a certain plan for a few years, I hesitate to continue this agitation. If this plan does not succeed that matter will still need to be settled. It seems to me more desirable to do something which is more likely to be final. The difficulties which are likely to arise usually have fundamental and underlying causes. In this case it is geographical and this fact should be taken into consideration. Town control has been proved to be eminently successful. I made a tour of the Falmouth beaches today. They seem to be excellent and are administered in the way in which the people in the particular district desire. Some of them are restricted; others are not."

Dr. Glaser: "When the matter of cost is being considered, it might be of interest to consider that under plan (4) the community will be concerned; under plan (1) you can get a great deal more support from certain individuals than for any of the other plans. This might influence the town when confronted with various suggestions."

Mr. Compton: "Dr. Goodrich is evidently not as good in historical research as he is in biological research. Dr. Meigs had made an effort to get an association to take over the Lot X. Before Dr. Meigs bought the lot a number of Bay Shore lot owners agreed to buy Lot X and the beach from the Fay Estate. Dr. Meigs thought the proceedings would be slow and so bought it himself from Miss Fay, who, by the way is always being spoken of in the newspapers as doing something for the Town—she has done it at Dr. Meigs' expense.

"As to the statement about the Protective Association, this did not make any effort at all—it did not think the work was within its province. So there is really no means of knowing that private ownership would fail. As a matter of fact, before Dr. Meigs bought the lot, two or three of us went around to get subscriptions that amounted to $10,000 which would have been immediately available at that time. It was not difficult to get—and it was only the Bay Shore lot owners who were asked to contribute; no M. B. L. people were asked."

Dr. Goodrich: "I believe I was quoting Dr. Meigs. I wish that I might be corroborated or corrected."

Dr. Meigs: "Both statements are true but perhaps something might be added to the picture of the whole situation. I did not know that so large a sum was available for this purpose. As a matter of fact, it was difficult to decide whether the lot should be transferred to Mrs. Meigs and myself, or to an association of Bay Shore lot owners. It was quite complicated because we wanted the lots reserved in perpetuity, while they

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wished them to run as long as there were restrictions on the lot—which is until 1961. Miss Fay's representative finally agreed with my lawyer that the price should be reduced from $10,000 to $8,000 in order that they might have the privilege of bathing there. Owing to poor health I was unable to take an active part. But soon after my recovery I heard from the lawyer that the deed had been put through transferring the lot to us for $8,000 and that at the time he had presented his bill for $1,890. He expressed a great desire to form an association and put stock out, but the bill for transference was a sufficient blow, so we dropped the matter of forming an association until we could find out how much money was available. My impression was—probably I did not get into sufficient communication with Mr. Compton—that the people who came forward offered much smaller sums than have just been mentioned. If anybody knows a lawyer who would act for a reasonable fee we should be glad to transfer the lot at any time to an association, to the laboratory, or to residents of Woods Hole.

"It seems unnecessary to give what we already have in Woods Hole to the Town of Falmouth. If there is any fear that members of the Laboratory will not be allowed to bathe there, something could very easily be arranged. It seems to me that to bring the Town of Falmouth into our dispute is unfortunate."

Mrs. Glaser: "A good many of the cottagers are attending the Theatre Unit because it is "Woods Hole night" at Silver Beach and are unable to attend the meeting. A number of them are not in favor of giving up to Falmouth what already belongs to Woods Hole."

Dr. Richards: "If plan (4) is voted on by this group, it is then recommended to the selectmen to propose to the Town of Falmouth that they take action, is it not? It is then purely a matter of politics. The other scheme would mean obtaining the permission of the owners and it then would be arranged by those concerned.

Dr. Grave: "It is correct that any proposal involving the Town must be passed at the Town meeting—and could, of course, be rejected."

Dr. Buddington: "The principal objection which I feel to plan (1) is that in the case of private ownership a sense of freedom is lost. Many people are sensitive enough to feel they are not free. Everyone who lives around here should have some place where they could go bathing without feeling that they were trespassing on someone else's property. Public beaches in Falmouth have been very successfully managed. The fact that this beach be open to the town of Falmouth would not mean that too many people would use it. Each section of Falmouth has its own beach. It seems to us that only people in this vicinity would care to use the Bay Shore beach."

Mr. Compton: "I should like to ask who is qualified to vote and who authorizes them to."

Dr. Grave: "As was stated in the public announcements, persons who make Woods Hole their home either permanently or during the summer or who are in attendance at the several biological laboratories, are invited and urged to attend a meeting."

A vote then was taken by a show of hands on the motion before the house—that plan (4) be recommended for adoption at the next Town Meeting. The motion was carried, 30 voting for it and 18 against.

Dr. Grave stated that the necessary means for presenting this action to the Town of Falmouth could be provided by the authorization of a committee, and the meeting voted that such a committee be appointed by the chairman.

Dr. Glaser objected, stating that the meeting should vote on all of the other propositions.

It was maintained that in voting for plan (4) all of the others were thereby rejected.

Mr. Compton objected that the ruling of the chairman that those who make Woods Hole their home and members of the Laboratory have the right to vote excluded other summer residents.

Dr. Grave then asked how many had failed to vote through such a misunderstanding—only two hands were raised which made it unnecessary to vote again on this question.

Miss Tinkham suggested, although plan (4) had been formally adopted, that the meeting be permitted to express its opinion on the other propositions.

An informal vote was taken by a show of hands on each proposition. The result was: plan (1) - 18 for, 34 against; plan (2) - 2 for, 39 against; plan (3) - 3 for, 37 against.

Mr. Compton asked the chairman when he addressed the selectmen of the Town with this recommendation whom he would say it came from, and if from a meeting, from a meeting attended by whom, "will you tell them that only thirty persons at a meeting held in this place voted for plan (4)?"

Dr. Grave assured Mr. Compton that there would be no misrepresentation.

Dr. Manton Copeland said he was certain that the meeting had absolute confidence in its chairman. This statement met a spontaneous burst of applause.

A motion was then made to adjourn.

THE COLLECTING NET

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GERM CELLS IN RELATION TO THE DIFFERENTIATION OF THE SEX GLAND[1]

Dr. B. H. Willier

Professor of Zoology, University of Chicago

This report deals with some recent work on the physiology of development of the sex gland of the chick embryo. It has been shown previously that the gonad rudiment of the genital ridge stage (50 s donors) when isolated and transplanted to the vascularized chorio-allantoic membrane of a host embryo, is capable of undergoing self-differentiation. This rudiment is thus found to be specifically organized as to sex, and in the case of the female, as to laterality as well. Such results led very naturally to a study of the potency[2] of the gonad-forming area in much earlier stages, that is, before the appearance of the genital ridge, and even before there is any sign of a definite germinal epithelium. In such an analysis two topics are of particular interest, namely, (a) the time of the origin of the specific potencies of gonad, and (b) the relationship of the primordial germ cells to the origin and differentiation (*Continued on page* 224)

M. B. L. Calendar

TUESDAY, AUGUST 23, 8:00 P.M.

Seminar: Dr. T. L. Jahn: "The effects of temperature and of certain organic acid radicals upon Euglena gracilis."

Mr. T. T. Chen: "Nuclear structure and mitosis in Zelleriella (Opalinidae)."

Miss Sabra J. Hook: "Some observations on Spirostomum ambiguum."

Dr. W. F. Hahnert: "Intensity duration relations in the response of certain protozoa to the electric current."

FRIDAY, AUGUST 26, 8:00 P. M.

Lecture: Dr. H. H. Gran: University of Oslo. "Problems in the Study of the Phytoplankton of the Sea."

EULIMA OLEACEA AND THYONE

George M. Gray

Curator of the Museum of the Marine Biological Laboratory

Many years ago, in the early days of the Marine Biological Laboratory and the infancy of the Supply Department, when the facilities for collecting were not as good as at the present time, there were occasions when material was needed on short notice. Under these circumstances, it was but natural that, even though the same animal might be found in a number of different localities, the places where a particular form was more abundant, or more easily accessible, was of paramount importance in the saving of time; and such localities were kept in mind. In this connection, the observations recorded in this article were made of the common Holothurian, or Sea cucumber (*Thyone briareus*) of Selenka.

This is the largest and most conspicuous Holothurian found in the immediate vicinity of Woods Hole, and, with the possible exception of Synapta, the most abundant. We know of at least seven

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places in this region where Thyone have been noted or collected in more or less abundance. We suspect there are others, as they have been taken rather sparingly on some of the field trips to places other than the seven referred to.

Two only of the seven places mentioned are the constant rendezvous of the Thyone student or collector, and these because of their accessibility or abundance of specimens; and of these two, one bears the brunt of the collecting. Yet, so far as the writer has observed, they are still abundant even though our veteran collector and preparator, Mr. F. W. Wamsley has for years operated principally in these two particular places.

Of the other five localities, we are concerned in this article with one only. Years ago the writer learned from experience that Thyone could be more or less easily collected by hand at almost any tide except perhaps the very highest, in this peculiarly favored spot, while the accessibility was if anything better than that of the other localities.

Perhaps Thyone is on the average smaller in this particular spot and may not be so abundant, as the area is evidently more limited. In cases of emergency, the undersigned has frequently hied to this favored cucumber patch and, regardless of tide conditions, has had successful results. In collecting Thyone on these rush trips to this special place, it was observed that now and then a specimen would have adhering to it a small yellowish-white, finely-polished Gastropod. At the time, the writer did not know them. They were for from plentiful, and he considered them very beautiful. In those days there was little time for anything except the actual work in hand, so that little attention was paid to them beyond a subconscious mental note, and as we usually collected Thyone when time was available and tide was right, from the regular and well-known grounds, some years passed before any systematic work on these Molluscs was attempted.

In August 1930 circumstances and conditions were such that a trip could be made to this ground for the special purpose of collecting and learning more about our charming little friend of previous years. On reaching the place, work was begun immediately. The tide was low and the Thyone easily seen and procured, rapidly examined and put back in the water, but no molluscs rewarded our search. After a goodly number of Thyone had been thoroughly looked over I was beginning to get discouraged and skeptical about finding them. Fears were entertained that what had been in the years long gone by was not to be at this time, but hope resolved itself into a stubborn persistence and Lo! right in hand was a Thyone with a beautiful specimen of the mollusc attached. What a splendid sight it was to our eyes grown weary with searching. Standing out in bold relief on the cucumber, like a Lighthouse on a barren shore, and needless to say just as welcome to us as the light to the mariner. What a joy it was to behold it!

Thus was renewed our acquaintance with this dainty mollusc, *Eulima oleacea* of Kurtz and Stimpson, but in the list of the Mollusca of New England, published by the Boston Society of Natural History in 1915 by Mr. Charles W. Johnson, the Generic name Melanella is given preference. Mr. Johnson lists five species as living in New England, two of these being found south of Marthas Vineyard, two others besides *E. oleacea* being found at Woods Hole. We feel convinced that the one found on Thyone is *E. oleacea*. Verrill in his Vineyard Sound Report mentions *E. oleacea* as generally rare, but in two instances several were found adhering to the skin of the large Holothurian, *Thyone briareus*, on which it appeared to "live as a quasi parasite or commensal." Sumner, in his "Biological Survey of the Woods Hole Region" in 1911 reports that "specimens of Eulima from various local points were referred by us to Messrs. Dall & Bartsch and were unhesitatingly identified by them as *E. conoidea*." Thus there would seem to be some confusion regarding the correct name of the species about which I am writing.

But, to return to the thrill and exultation over our specimen, after feasting our eyes on this lone example it was carefully removed to my collecting bottle. Though another might not be found on this trip, there was deep satisfaction in the thought that they were there. Hope and spirits revived and search was vigorously renewed. How much time was given to this search cannot be recalled, but probably between two and three hours.

In this time seven of these "dudes" among the small molluscs had been secured and in one (perhaps two) instances, two specimens were found adhering to the same Thyone. In searching for and securing these seven something like 250 Thyone were examined. This would mean an average of one mollusc to every thirty-five or thirty-six Thyone,—not a large percentage of molluscs.

We have since dredged Eulima very sparingly at scattered stations in Vineyard Sound and in one or two stations in Buzzards Bay. The number collected in dredging in recent years, of which the writer has personal knowledge, must be less than a dozen all told,—and possibly not more than eight.

On August 14th last year (1931), another special collecting trip for Eulima was made to the same Thyone ground as mentioned above. No actual count was made of the number of Thyone examined, but it was possibly 200 or more. Six specimens of Eulima were found— two of them on one Thyone.

When first collecting these snails it was feared that they would be easily washed off or rubbed off of the Thyone and readily lost, but such was not the case, as they evidently penetrated the Thyone skin. It took some little effort to dislodge them; they had to be pulled from their host, and there was observed a long, fine, whitish, thread-like extension of the Eulima, the proboscis. At first this seemed very unlike a proboscis. It was slowly withdrawn by its owner. At the laboratory several methods were tried to narcotize these snails, but none seemed to work so that they could be killed in an expanded condition. Sometimes after doping them they seemed dead and withdrawn into their shells, but after giving them a fresh supply of sea water they quickly revived and started crawling about. Up to date none have been killed properly expanded.

It seemed as though, if the "dope" did not appeal to them they would withdraw into their shells and wait until the unpleasantness passed, and if it did not pass and they were given no fresh sea water, they died after a while, withdrawn into their shells. As a rule they were very hardy and some lived for many days in a vial half or two-thirds filled with sea water. Frequently they would crawl up out of the water and adhere to the side of the glass.

In addition to its general attractiveness, Eulima has a thin shell mouth opening, so clear that when it is out walking in its native haunts, free from care or fear of enemies, it thrusts out its tentacles and moves along over the bottom with the beautiful and prominent black eyes showing remarkably clearly through the thin transparent shell, giving an effect of daintiness and style to this aristocratic-looking denizen of the sea. The writer at this time does not recall any other gastropod of this region which can claim this distinction of having the eyes so clearly seen through the shell. The dark eyes showing through the finely-polished creamy-white shell give to the whole animal a striking and attractive appearance. But only when the tentacles are well extended can be seen the full measure of its beauty, as the eyes do not show in its retracted state.

Since Eulima had been dredged from places where in all probability there were no Thyone, (as the former came up by themselves and the latter not at all), the thought came to me, "why should not Eulima be found living separately and free from Thyone, even in this especially favorable locality, as well as on Thyone? Did they *have* to live on Thyone?"

With this in mind a special trip to my loved Thyone ground was made late in the Fall, to test out the idea. A saucepan with a moderate handle was used to take up the mixed sand and mud to the depth of about two inches. This was dumped into a series or nest of three sieves, the coarser one at the top and the finer one undermost. At almost the first sifting a Eulima was found free from any Holothurian. The work of digging up and sifting this muddy sand was carried on for about one and a half hours. When the time was up, as a result of this indiscriminate collecting, I had twelve fine specimens of Eulima, eight of which were loose and unattached to Thyone, three of which were taken in one sieving. Sometimes Thyone was accidently scooped up with the soil but on these occasions only four Eulima were found on Thyone and two of these four were found on one cucumber. While sometimes Thyone were in the sieve with the loose Eulima, there was nothing to indicate that they had been attached to them, as the sieving was carefully done. When it is considered that only seven Eulima were obtained last year in handling 250 cucumbers and this year twelve were secured in much less time and with not more than fifty of sixty Thyone handled, and these taken accidentally, it would seem that there were more Eulima living in the sand or sandy mud free from Thyone than there were attached to them.

This opens up an interesting problem: "When and how did this commensal living begin? Is it another case similar to that of the New Zealand Parrot?" It has been suggested that perhaps Thyone in its moving about came in contact with Eulima and appropriated it as it does sand, dead shells, and small stones, as well as other small molluscs, which are often found attached to itself by its long suckers or pedicilaria; and thus by accident Eulima may have found the attachment served on it, a blessing instead of a handicap. The water at the time of collecting was less than two feet deep, and the tide was fairly well up, so it must be that at a very low tide the flats would be quite bare and that where *some* of the Eulima and Thyone live they would be quite exposed.

In this last collecting trip a fine living specimen of *Scalaria lineata* was taken as well as some Turritella (sp. ?), and several dead shells of what seemed to be *Scalaria multistriata*. This indicates that the field is rich in small molluscs, but at this time being especially interested in Eulima, I confined my attention to the latter.

In order to test out more clearly the relations between Eulima and Thyone I carried out the following experiments. I kept a number of the Eulima alive in the laboratory for some time. After several days a live Thyone was put in a finger bowl of sea water which had a little sand in the bottom. Five Eulima were put in at night on the opposite side from the Holothurian. The next morning two or three were on the Thyone and the others were in other parts of the bowl.

The water was changed. I think it was the next day that nearly or quite all had left the host. They seemed to come and go as the spirit moved them. One day the water was changed and when left there was not more than one Eulima on the Thyone. The next morning the whole five were on the cucumber. They were easily removed from their host, and in no instance were they so firmly attached to the Thyone as when they were originally collected in their native habitat.

It may take more or less time for Eulima to work its way into the good graces of its host, but in the laboratory they seemed quite loosely attached, whereas in the field it required a little pull for them to let go, and then with seeming reluctance was the proboscis pulled out. Sometimes it seemed to me that the proboscis pulled apart, but of this I was never quite sure.

One morning the whole five were on the Thyone. The water was changed in the afternoon, and at this time two were under the sand, the others on the Thyone. At night more sand was added and all the Eulima were taken from the Thyone, and they were placed in a bunch together, removed as far as possible from the Thyone.

The next morning three of them were on the Thyone, the other two on the sides of the bowl. Later in the day two were on the Thyone, one was floating on the surface and two were under the sand. They float on the surface of the water very easily, almost as lightly as a feather. They can also move along on the surface of the water with the shell hanging down.

Late in the afternoon two were taken from the Thyone and all laid on the sand in the finger bowl of water. When lifting the cucumber from the water those that were attached would sometimes hang down almost a fourth of an inch before dropping off, suspended by their proboscis, which looked like a fine, whitish thread.

The next morning we found four Eulima on the Thyone and one under the sand. In the afternoon they were all on Thyone. The next morning five were on the cucumber. When this Thyone was disturbed all but one dropped off.

After this experiment they were all changed to a larger, (six-inch diameter) glass dish. More sand and sea water were added. Thyone was placed on one side of the dish and five Eulima as far removed as possible on the opposite side of the dish, four inches away, on top of the sand.

The cucumber eviscerated the third day, but it seemed all right. After three days, however, the Thyone became unattractive to the molluscs and the Eulima mostly shunned it. I do not wonder at this, as the cucumber became quite unsavory at the last, and lived only a short time after evisceration.

I have perhaps gone into a tedious repetition of the habits of Eulima in attaching themselves to, or in leaving its Holothurian host, but I wished to emphasize the fact that Eulima is a free moral agent and is not obliged to live on the Thyone but is independent and moves of its own sweet will to wherever the spirit prompteth. Sometimes it had the habit of resting on a piece of Ulva which was in the dish.

It seems rather strange that, if Eulima is so seemingly fond of Thyone, in the larger fields where the latter is so abundant this mollusc has not, to my knowledge, been found. I have questioned our veteran collector, Mr. Wamsley, who is a keen observer and has perhaps collected and preserved more Thyone than any other man, and he does not recall ever seeing this little snail, for all he has handled thousands of Thyone. Even the Invertebrate class of the Marine Biological Laboratory has I believe, no record of taking Eulima on its trips to the regular orthodox cucumber ground. Yet it has been taken by dredging on either side of the major Thyone fields.

A word in regard to the attaching of this snail to the sea cucumber may not be amiss. In the field the Eulima was always attached to the underside of the Thyone and among the ambulacral feet. This would seem to indicate that Eulima became attached to Thyone by accident in the latter's moving about in the sand. From this circumstance may have originated the quasi parasitism of Eulima. In the finger bowl in the laboratory they were not so particular, though usually preferring the underside of the Sea cucumber.

More extensive observations are being planned in the study of this mollusc, Eulima, for the coming season.

GERM CELLS IN RELATION TO THE DIFFERENTIATION OF THE SEX GLAND

(Continued from page 221)

of the sex gland.

For this present series of experiments donor embryos of stages ranging from 29 to 41 somites were used. They fall into two categories: (1) from 29-34 somites—stages prior to the formation of a germinal epithelium, the prospective gonad area extending from the twentieth to the twenty-sixth somite levels; (2) from thirty-five to forty-one somites—stages at which a germinal epithelium has differentiated, that is, the earliest beginning of the gonad rudiment. The entire urino-genital ridge was dissected away very carefully from these donors and transplanted to the chorio-allantoic membrane of host embryos of approximately nine days incubation, where they were allowed to grow for a period of about nine days. Eighty-five such grafts have been examined histologically. Since the entire urino-genital ridge was transplanted, the grafts consist, typically speaking, of mesonephros and suprarenal in addition to gonad or some gonadal component.

With respect to the differentiation of the gonad, the results briefly stated are of two types: (1) a gonad of specific sex (testis, left and right ovary) differentiates in 39% of the cases; (2) a gonad-like body of undetermined sex differentiates in 56% of the cases.

When they do occur, the testes and ovaries are histologically normal in structure although definitely smaller than the normal of a corresponding age. The earliest stage of donor from which a gonad of specific sex (ovary or testis) was obtained was thirty-one somites.

The gonad-like bodies of undetermined sex vary considerably in organization from masses of stroma-like tissue containing few germ cells to a rather highly organized body with sex cords of germinal or non-germinal cells, bearing a close resemblance to a specific gonad.

The frequency with which a gonad of specific sex occurs bears a striking relation to the developmental stage of the donor at the time of transplantation. For example, donors having from 29 to 34 somites, i. e., before the germinal epithelium has developed, give gonads of specific sex in 20% of the grafts while a little later where the germinal epithelium has made its appearance—35 to 41 somite donors — the frequency increases to 57%. Still later after the formation of the genital ridge a gonad of specific sex occurs in approximately 100% of the cases. Turning to the gonad-like bodies of undetermined sex, it is seen that they occur with nearly equal frequency before and during the formation of the germinal epithelium, but when the genital ridge stage is reached, they are entirely absent.

It is quite evident, therefore, that there is a progressive change in the properties of the gonad-forming area. This change is interpreted as indicating that the gonad-forming area possesses an organization at the time of isolation, which, provided that conditions are favorable in the graft, may acquire through a series of processes the specific potentialities of sex. If, on the other hand, conditions are not favorable, such processes may be halted at different stages, resulting in various grades of gonads undetermined as to sex. In other words, the process of epigenetic development continues to a variable degree depending upon the developmental harmony within the implant.

In over 80% of the grafts examined germ cells are seen to be extra-gonadal, being found in clusters, sometimes quite numerous, either in the mesenchyme itself or in spaces within it. In such germ cells the granules of the cytoplasm are uniformly distributed, a characteristic of the primordial germ cell. It is thus apparent that the germ cell in the mesenchyme has remained undifferentiated. The germ cells in the sex cords, on the other hand, have undergone differentiation as is indicated by the localization of the granules in the cytoplasm at one side of the nucleus. The granules of the germ cells are larger in female than in male sex cords. These observations lead to the conclusion that the primordial germ is dependent upon a specific tissue environment for its differentiation into specific sex cells.

In two grafts (33—and 37—somite donors) a testis with sterile sex cords has appeared. In both of these cases germ cells were identified in other parts of the graft. For some reason they failed to get into the sex cords. A sterile testis has also been obtained in a small number of cases (4 out of 50) from grafts of whole blastoderms of early somite stages. In these cases the crescentic area anterior to the embryo proper was removed, where according to Swift the primordial germ cells originate. These results appear to furnish proof that (a) a testis may arise and differentiate independently of the primordial germ cells and, (b) the germ cells are extra-gonadal in origin.

[1]The title of this article was abbreviated. Its full title is "Germ Cells in Relation to the Origin and Differentiation of the Sex Gland of the Chick as Studied in Chorio-Allantoic Grafts."

(This article is based on a seminar report presented at the Marine Biological Laboratory on August 9.)

THE SURFACE PRECIPITATION REACTION IN MARINE EGGS

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If a living cell is torn or crushed, the interior protoplasm streams out, and typically, if sufficient care is exercised in making the injury, a film or membrane forms on the surface of the exuded droplet. The reaction which underlies this film or membrane formation has been called "the surface precipitation reaction" by Heilbrunn.

A more or less standard procedure was employed in the experiments as follows: a few eggs in sea water were placed on a slide under a coverglass, the slide placed on the stage of the microscope, and the water drawn slowly from beneath the cover by pieces of filter paper applied at the opposite sides. At the moment that the vitelline membrane ruptured, the filter paper strips were removed, and the outflow of protoplasm stopped almost instantaneously. For eggs of small diameter, or with heavy vitelline membranes, the pressure required to rupture the membrane exceeded that obtainable by this method. In these cases, additional force was applied upon the coverglass with a fine needle directly above the cell under observation.

A second procedure was employed to determine whether or not the granules contained in the protoplasm were causally related to the precipitation reaction. This consisted of centrifuging the eggs until the contained granular protoplasm was stratified into layers. The eggs were then removed from the centrifuge tubes and crushed. If one type of granule is a necessary requisite for the precipitation reaction, the reaction should not take place if the vitelline membrane is ruptured at the opposite pole of the egg.

The eggs of Gonionemus, Arbacia, Asterias, Echinarachnius, Cerebratulus, Phascolosoma, Nereis, Podarke, Amphitrite, Hydroides, Chaetopterus, Crepidula, Cumingia, Mytilus, Chaetopleura and Styela were used in the experiments. In all of the forms except Nereis, Podarke, Crepidula and Styela, the surface precipitation reaction resulted in the formation of a definite limiting membrane about the exuded protoplasm, similar to those described by Heilbrunn for Arbacia. In Nereis and Podarke the reaction resulted in the formation of precipitated areas of protoplasm. In Crepidula and Styela no typical reaction was obtained, perhaps because of the concentration of yoke granules in the cytoplasm. In the latter form surface precipitation membranes were obtained from the more fluid protoplasm of the germinal vesicle. These phenomena did not occur in sea water from which the calcium had been removed by oxalate.

In Arbacia, Asterias, Echinarachnius, Cerebratulus and Nereis, the formation of the membrane (or precipitate) was accompanied by a breakdown of the protoplasmic granules (yolk granules). In Arbacia and Echinarachnius the pigment granules in direct contact with the injured protoplasm broke down with characteristic color reaction. In all of the other forms no granule breakdown occurred.

The surface precipitation reaction assumes a characteristic form for each species studied. Two general types of reaction occur: one which is accompanied by the breakdown of some type of protoplasmic granule; and the other in which there is no granule disintegration. The presence of calcium is in all cases a necessary requisite.

(This article is based on a seminar report presented at the Marine Biological Laboratory on August 9.)

SIZE OF EXPLANT AND VOLUME OF MEDIUM IN TISSUE CULTURES

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Tissue culture provides a method whereby small fragments of the organism may be kept alive, isolated from the entire organism in a medium the composition of which may be controlled. Consider a small mass of tissue in the intact animal. The cells can neither be seen nor their physiological processes measured, except indirectly. The cells are bathed by intercellular fluids which are affected by changes in the blood. The blood is continually altered in composition during its course through the lungs, liver, intestine, kidney, endocrine glands, etc. It is a heterogeneous system, and tremendously complex. Contrast this with the situation in tissue cultures. A bit of tissue is isolated from nervous elements. It can be analyzed, measured, weighed, or the cell population enumerated during an experiment. The types of cells may be seen and photographed. The medium, in intimate contact with the tissue mass, is a field of knowable factors which affect the processes of growth, differentiation, senescence, and motion in the culture. These variables are subject to quantitative experimental control.

This paper presents the results of varying the size of explant and volume of medium in tissue cultures (of chick embryonic spindle cells, grown in chicken plasma and chick embryonic extract) noting the corresponding changes in relative increase in growth. It has been found that (1) the smaller the explant in the range of 0.1 to 2.5 $mm.^2$ of projection area, the greater the relative increase in growth; and (2) the larger the volume of medium (0.02 to 0.12 cc.) the greater the relative increase in growth. Change in size of explant produces a greater change in relative increase of growth than change in volume of medium.

These results are considered to be those expected on the hypothesis that with a small explant in a large volume of medium, conditions are most favorable for the cells to grow. With a large explant and a smaller volume of medium, the interior cells of the explant are relatively unfavorably situated. This may be because of slow diffusion to the interior cells with consequent exhaustion of nutrients and greater concentration of metabolites. Such centrally located cells may thus contribute an inhibiting influence on the more favorably located peripheral cells. Thus the relative increase in growth is thought to be roughly proportional to the length of the edge and inversely proportional to the diameter of the explant, other things being optimum.

Another type of result may have been expected from this experiment. The medium may be slightly unfavorable, e. g. slightly off optimum pH. The larger piece of tissue may then have a greater capacity to condition the medium to its maximum growth than the smaller piece; hence, it would recover sooner and show a greater relative growth than the smaller piece. Such results have been reported for protozoan, bacterial and yeast cultures. The experiments reported here deal only with the most favorable conditions obtainable.

(This article is based on a seminar report presented at the Marine Biological Laboratory on August 9.)

DIRECT ORAL ADMINISTRATION AND THE TOXICITY OF IODIN IN VITAMIN A DEFICIENCY

Dr. F. E. Chidester

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In 1912 the writer engaged in a study of the influence of sub-toxic doses of thyroid and other endocrine extracts on fowls, guinea-pigs and rabbits (1). In 1918, in experiments made at the Wistar Institute, the results of which were not published but recorded in the laboratory notes of Dr. H. H. Donaldson, he showed that heavy doses of thyroid extract and thyroxin (furnished by Kendall) produced resorption of the young in pregnant rats. Pioneer studies of Cameron and Carmichael, (2); Carlson, Rooks and McKie (3); Hoskins (4) and others had emphasized the toxicities of thyroid extract and iodin, and the significant changes in organs induced by heavy dosage. Besides this the long record of usage of these substances in weight reduction, had indicated the necessity of furnishing experimental animals only with minute doses. In considering the use of iodin compounds in vitamin deficient rats, we had to take certain precautions about mishandling the animals, and also to observe the dicta laid down by physicians with reference to the administration of drugs, *with food,* rather than directly to animals that had been starved and were also without food in the stomach when drugged.

Accordingly, after certain preliminary experiments, the writer (5) and associates, Eaton, Thompson, Speicher, Bourne, and Wiles, adopted the procedure of administering very weak ferrous iodide indirectly by dropping it into dishes containing small quantities of the food given the thoroughly depleted vitamin A deficient rats. This method presumably gave the animals most of the iron, but we were by no means certain about the amount of iodin actually consumed.

Perhaps some of the iodin escaped into the air, and the benefits derived were from furnishing young rats the added iron that they required after the period of suckling, when their iron reserves are known to be very low (6). We conjectured from the results that the small amount of iodin carried into the animal with its food may have exerted one of several effects: (1) Reactivation of the dormant thyroids, calling on reserve fats; (2) reactivation of the liver in its function of desaturation of fats; (3) antiseptic action of the iodin on bacteria, reducing infections and acting indirectly as a sparing agent on vitamin A reserves.

The studies of Reed, Anderson and Mendel (7) have shown that in thyroxin fed rats the depot fat is more unsaturated than in controls. The antiseptic action of iodin in respiratory and digestive affections has long been known, and its significance pointed out by McCarrison and others.

Since our results indicated that we were producing beneficial effects only in the small proportion of the rats that had the greatest fat reserves, we cast about for the proper fats (8), until, from the important studies of Burr and Burr (9), we concluded that unsaturated fatty acids such as linoleic acid would best serve our purpose in restoring the fat-iodin balance, and yet permitting the catalytic activities of the ferrous iron and the iodin. That our successful experiments (10) may ultimately be considered by others is evidenced by the recent studies of Monaghan and Schmitt (11) with carotin and linoleic acid; they have concluded, apparently without knowing of our findings, that the phospholipids are possibly related to vitamin A formation in the body.

This past year we have demonstrated (report in progress) that the fat content of yeast furnished as vitamin B is an extremely important limiting factor in vitamin A experiments.

The amount of vitamin D, given as irradiated ergosterol or in irradiated yeast, plays an important part in recoveries also. This may be on account of the influence of calcium on the thyroids, as indicated by Hellwig (12), who produced goiter in rats by excess calcium. Perhaps the excess vitamin D induced a calcium-iodin imbalance and our added iodin satisfied the need of the animals, enabling them to manufacture their own vitamin A.

Recently Mason (13), attempting to utilize ferrous iodide as a *complete* vitamin A substitute, but not following our reasoning about the necessity for also supplying fats of a certain type (5), has reported results quite at variance with our findings. We believe that his explanation of the possible differences in thyroids of the two colonies is not the only one. He reported administration of our dosage of iodin, *double* the dosage, and *excessive* dosage. Examination of the testes of his treated animals showed degeneration.

In a personal communication, the writer has suggested to Dr. Mason that (1) lard used in some of his experiments might induce a gastritis in the depleted animals; (2) when greatly depleted, sick animals are forcibly drugged, on an empty stomach, the iodin taken into their bodies will probably exceed that obtainable by our method, and will be most likely to induce conditions demonstrated by Cameron and Carmichael; (3) since ferrous iodide is certainly not tolerated by depleted rats in any but minute doses, we could hardly expect that *massive* doses would produce the beneficial effects desired as even excess vitamin D is deleterious; (4) increased testis degeneration is to be expected with added iodin. We have already reported our thesis that vitamin E effects are probably due to the action of unsaturated fats in restoring the fat-iodin balance. (Chidester: "Zoölogy," Van Nostrand, 1932).

More recently, Miss Cameron (14), desirous of securing glands for study, adopted a method that seemed to her more *exact* than ours in evaluating the dose of iodin actually received by A-deficient rats. Using freshly prepared solutions of ferrous iodide similar to ours, she pipetted the dose *directly into the mouths* of her rats and secured no benefits on vitamin A symptoms. Her results, we believe, support our contention, previously published (15), that in Burr's fat-deficiency disease the condition, restored by linoleic acid and certain other fatty acids, but not benefitted by cod liver oil (which contains iodin), was one in which unsaturated fatty acids, without iodin, were definitely indicated.

In our own experiments, we were attempting to discover the effects of *minimal* effective doses, without handling the animals excessively, and without taking a chance on the potency of drugs administered quickly to sick animals in the absence of diluting and guarding foods. Ours, in other words, was not a test-tube experiment. Testing four rats, this past winter, we used a solution of ferrous iodide, only one quarter the strength of the effective one, and by *direct oral administration* to the depleted animals killed all of them in less than six hours. Using a pipette, delivering 30 drops to a cc., we had previously found that the addition of five drops instead of three drops to our food caused many more deaths in our recovery groups.

Adoption of our method of administration was due in part to long acquaintance with the toxicity of drugs given to depleted animals on an empty stomach and also to other experiments in which we had shown that even in normal animals low dosages of thyroid or iodin will stimulate the appetite and increase growth, while heavier doses induce emaciation and changes in the organs.

It is not at all flattering to us to realize that among that large group of vitamin students who have long discredited our suggestions regarding the importance of fat-iodin balance in vitamin deficiencies, the only two who have honored us by their interest should have failed to read our later reports (10, 15) attempting to show that *catalyzers* such as ferrous iodide do not suffice and that *unsaturated fats* or *hydrocarbons* are necessary in aiding the animal to manufacture vitamin A.

Honeywell, Dutcher and Ely (16) have also recognized the probability that vitamin A consists of two factors, although they were not specific with reference to the rôle of unsaturated fats and hydrocarbons (17).

It is likewise a commentary on the enthusiastic reception of certain papers in the field (that the vitamin enthusiasts will-to-believe) that the only paper which purports to show that fats are not significant in vitamin A recoveries should be based on the studies of Hume and Smedley-Maclean (18) made with six animals. Their recoveries, moreover, were run for only thirty-nine days. Our own experiments indicate that sporadic improvements in vitamin A deficiency may occur with a variety of treatments, including the addition of vitamin D. They also indicate that great individual differences in storage exist, and that recovery periods must run far in excess of thirty-nine days in order to be acceptable.

We found that ferrous iodide, administered in the food, benefitted some animals as long as ten months. Our experiments were repeatedly checked for more than two years. We conclude that any explanation of the effectiveness of substances that enable animals to manufacture vitamin A in their bodies must consider the rôle of unsaturated hydrocarbons and fats in their action on the liver and endocrine glands which will restore the fat-iodin balance.

Dismissal of our own careful studies, made with large numbers of animals and with the aid of five well trained and highly competent assistants, the results being shown to many observers, cannot be lightly made, even if identical technique were employed. Such technique would include the high temperature essential in treating depleted animals, the extreme care exercised to eliminate insects and other vermin, the type of sources of vitamins B and D, and most certainly the less exact, but presumably less injurious, method of furnishing the ferrous iodide in small amounts of food to prevent too rapid reception of powerful oxidizing agents and intestinal antiseptics.

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REVIEW OF THE PAPER: "DIRECT ORAL ADMINISTRATION AND THE TOXICITY OF IODIN IN VITAMIN A DEFICIENCY" BY DR. CHIDESTER

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This interesting paper by Professor Chidester is a reply to certain criticisms of the favorable results he and his colleagues obtained in adding ferrous iodide in small quantities to the food of rats on a diet deficient in vitamin A. The author states that ferrous iodide, in more than minute amounts, is very toxic for such animals and his critics have made the mistake of feeding it directly to the rats, without food; whereas in his experiments the substance was added to the food and ingested with it. He now states that farther experiments, which are published elsewhere, benefitted certain animals enabling them to live for periods much longer than the controls and "some animals for ten months." He lays stress upon the necessity of providing the rats with unsaturated fatty acids in the diet as well as with some ferrous iodide.

To what extent ferrous iodide may enable a rat to manufacture vitamin A, or in other ways to withstand deprivation of this vitamin, can only be established by experiment; and calls for no comment except experimental work. But the author in this and previous papers has raised the very interesting question of the manner in which vitamin A acts in the body. He and his co-workers have attempted to bring it into relationship with the iodine metabolism of the body, and so with the thyroid gland and its internal secretion; and through this relationship with the whole question of fat metabolism, which is one of the most obscure chapters of the chemistry of the body. Also he connects it with McCarrison's work on goitre and the iodine—fatty acid—phospholipid—and calcium balance in the body. Carotin is the precursor, or a precursor, of vitamin A. This carotin is a highly unsaturated, aliphatic compound with eleven double bonds. Like all such compounds it has the property of taking up iodine at these bonds. Cod liver oil, which contains vitamin A, also contains small amounts of iodine. The feeding of thyroxin, the active principle of the thyroid, greatly increases the oxidation of fats and, since desaturation is an indirect result of oxidation, or rather the expression of an oxidation, it increases also the amount of desaturation of the fatty acids in the fat depots of the body. It has been shown also that the spontaneous oxidation of linoleic acid is stimulated by the presence of small amounts of the oxidation product of carotin. It is also established that vitamin A is necessary for the health of the intestinal epithelium; and that it may play as important a part in the absorption of iron from the intestin as vitamin D does in the absorption of calcium. All of these facts, together with others which indicate that the liver which is the great store house of vitamin A in the body is also of importance in the oxidation of fatty acids indicate that vitamin A may play a very important part in fat metabolism and be one of the factors, together with iron and thyroxin, in this metabolism. Dr. Chidester's suggestion that the favorable effects of ferrous iodide in vitamin A deficiency are to be thus explained has, hence, much in its favor. He seems also to have made out a strong case for the beneficial action of ferrous iodide, a remedy long used in medicine.

This work of Dr. Chidester, and in particular the several important suggestions made by him in the course of the work, such, for example, as that "iodine may be important in the prevention of tumors," may have important practical results. It emphasizes, for example, the importance in therapeutics of the iodine contained in cod liver oil; a therapeutic possibility hitherto almost completely overlooked. Indeed so extensive has the advertising of vitamin D become that the erroneous notion is apt to become prevalent that cod liver oil can be replaced therapeutically by pure vitamin D preparations. While the iodine in the oil is in small amounts, it may, indeed must, be of value to the body. The unsaturated acids and above all vitamin A are also of importance in considering the action of the oil. Furthermore the work may ultimately be brought into connection with the disturbed metabolism, and in particular with the phospholipid metabolism, of malignant growths; it thus touches the important work of Professor Mayer, Professor Schaeffer and Terroine in France on phospholipid metabolism; and that of Professor Tashiro and his pupils in this country on bile salt metabolism and its relation to phospholipid metabolism and stomach ulcer.

In fact it is curious to reflect that vitamin A and minerals may have somewhat the same relation to the burning of fats in the body that turpentine has in every paint mixture; and that the painter in adding turpentine to hasten the oxidation of his linseed oil is doing essentially the same thing that the biochemist does in adding carotin, a substance which so easily passes into a terpene, to the food of his rats.

THIS YEAR'S ECLIPSE OF THE SUN

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(Continued from the last number)

It is doubtful, however, if any eclipse, for many years to come, will be seen by as many astronomers and lay observers as the one this year, assuming that favorable weather conditions permit it to be seen all along the track. A preliminary list of the expeditions, prepared by Dr. Frederick Slocum, chairman of the American Astronomical Society's eclipse committee, supplemented by several others known to the writer, shows twenty institutions represented, at nine separate points along the path of totality. The locations selected by three of the groups is unknown at the time of writing. Also, several other institutions, that frequently observe eclipses, have not yet announced their plans, and it is certain that a number of other parties will be present.

Northernmost of the stations will be Parent, P. Q., a small town on the Canadian National R. R. The Royal Observatory at Greenwich, under Dr. John Jackson, chief assistant, and the Dominion Observatory at Ottawa, under Professor R. Meldrum Stewart, the director, will combine forces at Parent. Montreal, though it is near the edge of the path, has the advantage of a permanently established observatory at McGill University, and this will be used by Professor A. S. Eve, of that institution, and also by Professor A. Fowler, from the University of London. At Magog, P. Q., the party from Cambridge University, under Dr. F. J. M. Stratton, will be joined by Dr. S. A. Mitchell's group, from the McCormick Observatory of the University of Virginia. Professor C. A. Chant will head the University of Toronto's expedition, at St. Alexis, P. Q.

Coming into the United States, the Sproul Observatory of Swarthmore College will erect its equipment, including the 65-foot eclipse camera, at a point in northern Vermont. At Lancaster, N. H., will be the Mt. Wilson Observatory astronomers, under the direction of Dr. Walter S. Adams. A group representing The Franklin Institute, Philadelphia, under the writer's direction, will be located at Conway, N. H., with a coelostat camera of 85 feet focal length, as well as smaller instruments. Dr. Frederick Slocum, of the Van Vleck Observatory, Wesleyan University, has chosen Center Conway. Across the state line, at Fryeburg, Maine, will be a concentration of several parties. These will include groups from the Lick Observatory, under Professor J. H. Moore; Georgetown University, under Rev. Paul A. McNally, S.J.; the University of Michigan Observatory, under Professor H. D. Curtis; and the Dearborn Observatory of Northwestern University, under Professor Oliver J. Lee. The Perkins Observatory of Ohio Wesleyan University, under Dr. Harlan T. Stetson, its director, and the Warner and Swasey Observatory of the Case School of Applied Science, under its director, Dr. J. J. Nassau, will combine forces at Douglas Hill, Maine. At Biddeford, Maine, will be the group from the Deering Observatory, headed by Mr. Frank Deering. In addition, the Kwasan Observatory of the Kyoto Imperial University, Japan, and the Russian National Observatory, at Poulkovo, have announced plans to send expeditions, the former in charge of Professor Issei Yamamoto, and the latter of Professor A. Belopolsky.

Practically all these parties will make direct photographs of the corona, and a few, like the party of The Franklin Institute, will specialize in this field. Besides the photographs with the long focus cameras, smaller instruments will be employed, some to make a motion picture record, others, for special purposes, such as photographs in natural colors. Attempts will be made to photograph the moon's shadow from an airplane. If the edge of the shadow can be photographed on the ground, together with recognizable landmarks whose position can be accurately determined, a very precise determination can be made of the relative positions in space of the earth, moon and sun. Still other photographs will be made of the partial phases, and possibly of the shadow bands, if they appear.

At least two prominent artists will paint the eclipse in oil, a method that has been found to give a more accurate record of how an eclipse really looks than any of the photographic processes. At York Harbor, Me., Mr. Howard Russell Butler will make a painting from his own summer home. Mr. Butler has painted the last three eclipses seen in the United States, but to do so he has had to travel to Oregon in 1918, to California in 1923, and to Connecticut in 1925. The paintings are now hanging in the American Museum of Natural History, in New York. But now the mountain actually comes to Mohammed! Mr. Charles Bittinger, of Washington, D. C., and Duxbury, Mass., is also known as a painter of scientific subjects, and has already done the solar spectrum and the zodiacal light. He will paint the eclipse as a member of the party to Conway from the Franklin Institute.

Perhaps the most important eclipse observations, however, are those made with the aid of the spectroscope, particularly of the so-called "flash" spectrum, an observation that forms the specialty of Dr. H. D. Curtis and of Dr. S. A. Mitchell. Just as the last shred of the solar disc appears at the beginning of totality, and just as it first reappears at the end, the sun's atmosphere shines unmixed with light from the inner region. Its spectrum is a series of bright lines, unlike the dark line spectrum of ordinary sunlight, and photographs of this spectrum yield much important information about the sun's constitution. Other spectrum photographs, made during totality, reveal the make-up of the corona. Photographs made with the interferometer tell how the material in the corona is moving.

Despite the question raised recently by Professor Erwin Freundlich, of the Einstein Tower at Potsdam, regarding the validity of determinations of the Einstein shift of starlight passing close to the sun, as measured on eclipse photographs by Eddington, Campbell, Trumpler, Chant and others, it is not expected that any plates to confirm this effect will be made this year. The sun is in a poor field, with no bright stars nearby. Professor James Robertson, the director of the Nautical Almanac, has called attention to the good star field that will surround the February 14, 1934, eclipse, so probably that will be used for the purpose.

Away from the path of totality, of course, the effects of the total phase will be missing, but the partial eclipse will be interesting to watch. This will be visible over the entire continent of North America. The closer one is to the total eclipse track, the larger the partial eclipse will be, but as far away as southern California the moon will cover nearly a third of the sun's diameter when the eclipse is at its maximum. Even at this distance, the crescent-shaped spots of light will be noticed under trees. At points as close as Denver, Colorado; Helena, Montana or Juneau, Alaska, the eclipse will be about fifty per cent. total. Atlanta, Georgia, will get 73 per cent., Chicago, 79 per cent., and Richmond, Virginia, 87 per cent. Philadelphia will get 93 per cent., New York 95 per cent. and Boston 99 per cent. In places as close as the last three, the peculiar yellowish color of the sunlight may be noticed, and it is possible that, where the eclipse is as much as 95 per cent. total, the shadow bands may be seen. In 1925 they were noticed at places a considerable distance from the path of totality. Also in these places, as at locations within the path, the chickens and other birds may be observed going to roost, as the darkness increases.

To the amateur astronomer, or photographer, the eclipse offers an unusual opportunity, especially if he be in the path of totality. While he can not hope to equal the work of the large cameras of the scientific parties, the amateur with a hand camera can make a very interesting record of this striking event. With a lens of 10 inches focus, the sun's image is a little less than a tenth of an inch in diameter, and if the picture is sharp, it can be enlarged considerably with quite satisfactory results. If a longer focus lens is available, it should be used. With a lens of not more than twenty or thirty inches focal length, and an exposure of not more than five seconds, the sun's motion will not be appreciable, and there is no need to mount the camera to follow the earth's diurnal motion. If the lens has a relative aperture of approximately F. 8, an exposure of perhaps two seconds can be given, though it is almost impossible to give a wrong exposure for such pictures. The inner corona is so brilliant that even an exposure of a fraction of a second will record it, while one of longer duration will overexpose the region, but will record the outer corona. Another interesting camera record can be made by taking a series of pictures at regular intervals such as every five minutes, of the partial phases and of the corona, on the same plate. If one has a 16 mm. motion picture camera, it would be of interest to use it also.

But whether or not one goes to make any observations, amateur or professional, it should be remembered that Wednesday, August 31, brings the chance of a lifetime to observe an impressive and beautiful natural phenomenon, and no one interested in such things should miss it if he can possibly avoid doing so.

BOOK REVIEWS

Nucleic Acids. P. A. Levene and L. W. Bass. 321 pp. Monograph Series, American Chemical Society. The Chemical Catalog Company, Inc. New York, N. Y.

This extremely valuable, timely, and useful book is owing to a combination of efforts on the part of the authors, of the Rockefeller Institute, and of the American Chemical Society. Each deserves a portion of the great praise which the book merits. In the first place Mr. John D. Rockefeller, by his foundation of a great research Institute, the Rockefeller Institute, provided the place, the funds, the assistance, and the living of the investigators who have made the greater part of the contributions to the chemistry of nucleic acids recorded in the book. To Dr. Simon Flexner must be given the credit of the wisdom of the appointment of Dr. P. A. Levene to the position he has held in the Institute. That appointment Dr. Levene by his industry and genius has far more than justified. To those who have assisted Dr. Levene in his investigations and to his co-author, Dr. Bass, must be assigned their meed of praise. But in addition to these who have contributed so much, especial mention must be made of the officers of the American Chemical Society and in particular of Dr. Chas. L. Parsons, the efficient secretary and moving spirit of the organization, for the part that organization played in arranging for the publication of a series of chemical monographs, many of which have already appeared, and of which this book is the latest and one of the very best. By means of this series American chemistry has taken its place beside German chemistry, as a leader in the diffusion of chemical knowledge. America has at last won its independence from Germany in chemical matters. We may well congratulate ourselves, in felicitating the authors, on the magnificent achievement represented by this volume.

The authors have not only given accurate descriptions of the nucleic acids and their constituents, such as nucleotides, nucleosides, the pyrimidine and purine bases, with methods for their preparation, but they have also given the history of their discovery and identification and proof of their structures. It was particularly pleasing to the reviewer to see the pioneer work of Miescher given its full measure of praise. Miescher was a biochemist of the first rank whose importance in the science is not always properly appreciated.

The book is written in a very easy and interesting style, the history introduced adding much to the reader's pleasure. The type is large and clear and the graphic formulas very well done.

There are one or two slight omissions which might be noticed. For example the very important reaction known as the 'nucleal' reaction discovered by Feulgen is not referred to in the index, and, so far as the reviewer could discover, in the text either, under this name. It is called in the text 'Feulgen's reaction.' It would no doubt be a convenience to have it carefully described and indexed, for its importance in identifying the thymo-nucleic acids in the cell is very great. But the most surprising and, in the reviewer's opinion regrettable omission is the lack of any special consideration of the physiological action of the nucleic acids and their decomposition products. It is true that some such observations are scattered here and there through the book, as, for example, the observations of Doyon and Vial on the powerful anti-coagulant action of a nucleoside. But it would have been a great convenience, especially for pharmacologists and pharmaceutical chemists, had there been a chapter in which the observations of physiological action were brought together. Perhaps in a new edition this lack could be supplied.

The reviewer does not regard the first sentence of the book to be an accurate statement of fact. That sentence reads: "The sugars entering into the structure of nucleic acids, d-ribose and d-ribodesose, belong to the group of pentoses." So far as d-ribose is concerned there is no criticism to offer; but as regards the d-ribodesose there is still doubt in the reviewer's mind, perhaps unjustified, whether this sugar preexists in the nucleic acid molecule. There are two facts which have not yet been explained by that assumption and these must be explained before complete proof is given that this sugar exists as such in thymic acid. One of these facts is the lack of agreement between the results of analysis of the preparations of thymic acid with the theoretical requirements if this sugar be present. But the second and more important failure is the lack of any explanation of the considerable amounts of formic acid which are set free at the same time that levulinic acid arises when the acid is decomposed by mineral acids. There is no doubt that deoxy-d-ribose has been isolated from nucleic acid. The only question is whether this is the substance in the nucleic acid itself. The formic acid must be accounted for. Might it not be that the sugar is a 3-deoxy-hexosone which decomposes into 2-deoxy-ribose and formic acid? The authors have insisted throughout the book on the necessity of the most rigid proofs and the explanation of every fact before accepting a conclusion; and on the basis of this insistence they give far greater credit, in the reviewer's opinion, than he deserves to E. Fischer for his purine work. Although he is of course deserving of great praise for that work. But they should apply to themselves the same rigid requirements; and it is only fair to say that this they have in general done. The reviewer hopes that they may be able to remove his doubt on this one point. Perhaps they have done so somewhere in the book and he has overlooked it. But the physiological importance of nucleic acid is evidently so great as to warrant the effort to establish its constitution beyond all question. And it must not be forgotten that hexose nucleosides are known to occur in nature. In the light of these facts I believe the wording of the first sentence should be modified.

Aside from these unimportant criticisms the book is deserving of the greatest praise. No where has our knowledge of nucleic acid been brought together so clearly and fully as here. In a sense the publication rounds out the life work, so far accomplished at least, and we hope there will be much more, of Dr. P. A. Levene. The book should be a great and legitimate source of pride to him and Dr. Bass as it is to every American. —*A. P. Mathews.*

Chemical Embryology, J. Needham. 3 vols., pp. xxi + 2021. Cambridge: The University Press; New York: The Macmillan Company. $35.00. 1932.

Joseph Needham has clearly had in mind, in preparing and writing this exhaustive treatise, the intent of founding with a classic a new segregate of science, and I for one cry "Success!" Even to one unacquainted with Needham or his antecedents it must be at once apparent that this is the mature product of a scholarly and industrious mind. The bibliography alone, almost 250 pages of titles, 35 or more to a page, which the author has actually consulted and the substance of which is handled in the text very largely in a critical manner rather than in the form of a compendium, attests the enormous labor behind this work. A small personal experience gives me reason to know the care expended, for a tale concerning Egyptian experiments on fetal development which came to me in anecdotal fashion and which I repeated to friends at Cambridge several years ago reached Needham's ears and elicited from him a letter requesting sources and authority, (which I unfortunately could not trace).

The great bulk of the volumes is devoted to a minute consideration of the static and dynamic chemistry of the egg and developing embryo, and includes a vast amount of detailed information, both in text discussion and numerous summary tables and charts. Such subjects as the general metabolism, energy relations, carbohydrate, protein, lipoid, mineral and other special metabolisms are given separate treatment. Further, the influences upon embryonic development of enzymes, hormones, vitamins, physical agents and the like are fully considered. Sections on the chemistry of the placenta, its rôle as a barrier, the amniotic fluid and of the more developed fetal tissues complete this portion of the work.

In connection with each type of approach to his more immediate material the author gives briefly the general relations and data on many other tissues and forms. Thus, for example, in the chapter on embryonic growth one meets an adequate discussion of much of the work of Crozier on temperature effects, Carrel's studies on tissue culture, Scammon's treatment of growth curves, and the like; while the succeeding chapter, discussing particularly differentiation, leads one far into the work of Child on gradients, the field of genetics, experimental embryology, and the like. Since the egg is a cell and one of the most convenient to use in attacking all manner of biological problems, Needham, in attempting to marshall all material on eggs, has left hardly any phase of biology untouched, and I doubt if one could browse in this work without finding much of interest to him, whatever his specialty be. One might mistrust the accuracy of handling material by one man over such a huge front, but a list of many dozen experts who have individually checked the portions impinging upon their immediate fields is considerably reassuring.

Not least interesting to the scientific reader is the 200 page section dealing with the history of knowledge and ideas regarding generation and ontogeny. To those acquainted with Needham's chart illustrating the history of biochemistry and physiology, no more need be said regarding this section.

To me a very real value of this work lies in its viewpoint and general treatment. Science in these days is following all too closely the general acceleration and impatience of daily life, and it is very refreshing to sense the tranquil scholarship, rooted deeply in the past of Cambridge University, flowing through these pages. From the Latin introduction, through a consideration of the underlying philosophical problems of biology, nowhere more acutely present than in a consideration of growth and differentiation, and through the examination of the development of his subject, Needham exhibits a serene mastery of his material and has expressed himself in charming passages.

Detailed criticisms can of course be made, and many will take issue with his mechanistic (but

not materialistic) approach to the great problem of differentiation, but few will fail to obtain profit and pleasure from an examination of his ideas and material. I am certain that all biologists would like, and many are able, to share the hope expressed in his closing paragraph. "The day may already be said to be in sight when the laborious description of embryonic conditions in verbal terms will be superseded by elaborate yet succinct nomograms, illustrating graphically all the stages or processes through which the organism passes or may pass. Fixture lists of the activities, chemical and morphological, of the fœtal organism, will reveal the exact point of action of lethal genes, and the master catalysts of growth and of differentiation will be found in bottles upon our shelves. The morphology and the biophysics of the developing embryo will merge into one single quantitative science, which shall show us how the metrical aspects of the finished living organism are derived from the metrical aspects of its egg."
—*R. W. Gerard.*

Vegetable Fats and Oils. George S. Jamieson. Pp. 444. New York: The Chemical Catalogue Company, $6.50. 1932.

In this volume the author has brought together a great deal of useful information concerning the vegetable fats and oils, especially those of economic importance. The book begins with a brief discussion of the occurrence, extraction and refining of oils. The discussion of these topics is very general but this in no way detracts from the value of the book, since these same topics are again discussed in detail in conjunction with various important oils. This method of presentation is desirable for in actual practice the methods of treatment vary somewhat, depending upon the nature of the substance from which the oil is extracted.

The introductory chapter is followed by three chapters concerning the properties, analytical constants, composition and utilization of tne oils. This discussion, which constitutes the major portion of the book, is replete with references to both the data recorded in older compilations and those to be found in recent papers. For convenience the author has divided the oils, as is customary, into three classes: the non-drying, semi-drying and drying oils. Under each of these headings the oils are discussed in alphabetical order.

The fifth chapter of the book is devoted to a discussion of the various components found in oils including sterols, hydrocarbons, and phosphatides. This is the weakest chapter of the book; in several instances the author has contented himself with a mere listing of the occurrence and a few properties of these substances, although appropriate references to the original literature are given. For some curious reason he has included data concerning the hydrocarbons found in animal fats and oils (pages 318-319). While welcome to the reviewer, one would not expect to find such data in a monograph devoted to fats and oils of vegetable origin.

The last chapter of the book is devoted to an excellent and detailed description of the analytical methods utilized in the study of the substances under discussion. For the most part the author has limited this discussion to those methods which he has found applicable in the numerous investigations conducted in his laboratory. This is distinctly advantageous since it permits of their critical evaluation in a manner which would otherwise be impossible.

In the appendix one finds a useful compilation of the analytical constants of the fatty acids, pure glycerides and naturally occurring oils. This is followed by a tabulation of the botanical names of the oil-bearing plants and their trivial equivalents in common usage. Two indices are included, the first an index of botanical names and the second a general subject index. The latter suffers from a lack of completeness and a lack of cross indexing.

Numerous typographical errors have escaped the proof-reader. This is extremely unfortunate in a book of this nature, since so much of its value depends upon the accurate presentation of a considerable amount of numerical data. Otherwise the book evidences most careful preparation and is to be highly recommended to anyone interested in the field which it covers.—*Kenneth C. Blanchard.*

THE CLAMBAKE[1]

An Heroical ballad inspired by a recent event

By E. E. Cornwall

A bunch of famous scientists
Did come from far away,
From Europe and points East and South,
To Beantown on the Bay.

(Now Beantown is a prideful town,
Where people sit and think;
Its favorite fodder being beans;
But nary drop to drink).

For one long week they lingered there,
In sessions scientific,
With no chance for a real good time.
The heat it was terrific.

Discussions, papers, speeches, talks,
From morning into night—
It certainly was much too much;
They were not treated right.

Now when it was becoming plain
That something must be done
To ease the situation and
Supply a little fun,

An invitation came to them
From a place beside the sea,
Where science flourishes indeed,
But not so seriously;

Where staid professors often sport
Beside the sportive wave,
While in the Lab. the starfish waits,
And doomed sea urchins rave.

Here, they were told, to honor them,
A clambake on the sand
Would be prepared—a wonderful feast,
They were given to understand.

With shouts of joy they all accept,
Feeling much elated.
From Harvard to the welkin far
The echoes reverberated.

They don't know what a clambake is,
But it means a holiday,
And getting away from program stuff,
And having a chance to play.

Now rumors of these goings on,
Of this festivity,
Spread o'er the land and through the sand,
And far out in the sea.

It roused especially in the clams
An interest intense,
For this gay party plainly was
To be at their expense.

Habituated to their fate,
They murmured not nor wept.
At cultivating stoic calm
The clam is an adept.

But a certain clam there was who, when
He heard of this jamboree,
Had an idea, and to the rest
These stirring words spake he;

"Some of us are doomed to grace
"This horrid holiday.
"Now I have a plan by which we can
"Make a grandstand play,

"And at the same time get revenge,
"At least in a small degree,
"For the outrages science wreaks
"On the denizens of the sea.

"These famous foreign scientists
"As molluscs know our brood;
"But being scarce in their home towns,
"We are to them strange food.

"Not knowing how we should be et,
"How needful 'tis to chew us,
"Some of them may swallow us whole;
"And that's when they will rue us.

"My proposition then, is this:
"Let old, tough, volunteers
"Die for the Cause—put themselves in the way
"When the clamdigger appears.

"It is very good form, as you know, to die
"For any popular cause.
"And these martyrs will get, where the brine is wet,
"Posthumously, applause."

And now behold the scientists,
The much distinguished band,
Some with whiskers, some without,
Foregathering on the sand.

Along with appetite and hope
Anticipation ran;
And all their tongues were hanging out,
They shouted as one man:

"We're here! We're here! Bring on the cheer!
"We're dry, and hungry too."
The Committee replied, pointing with pride:
"Now see what is waiting for you!"

They look around the festive ground,
And this is what they see:
Heaps on heaps of roasted clams,
Grinning maliciously.

With shells agape; and on the side,
Corn on the cob in stacks.
(Green corn is an ally of the clam
In his vicious attacks.)

The feast is spread, and all is set.
Thereafter what befell,
Must now be guessed. And so the rest
I will not try to tell:

[1]The "recent event" refers to the clambake sponsored by the Marine Biological Laboratory for the members of the XIIIth International Physiological Congress. The verses are reprinted from "The Medical Times", November, 1929.

FOG — Don't Be a Snob

(It seems quite appropriate at this time to reprint a little article which was contributed to THE COLLECTING NET in 1928 by a Trustee of the Marine Biological Laboratory.)

Don't be a snob! If you feel any of the symptoms coming on take a stiff dose of Huxley and Darwin, equal parts, or a liberal potation of Claude Bernard. If these fail there is a possibility in Christian Science. Try every resource; for snobbishness is a pernicious disease which saps the intellectual system and leaves the individual friendless and alone.

There are many manifestations of the disease some of which are easily recognized, others more subtle. The social snob is perhaps the most common and most easily recognized. His malady is usually complicated by an inordinate tendency to climb; and he becomes a specialized gymnast on the social ladder patronizing and even contemptuous toward those below him, obsequious to those above. In consequence he is scorned for in reality he is lower than all.

Another type is the intellectual snob. He prides himself on his erudition; he scorns the hum drum topics of daily life and converses freely only with those whom he secretly believes know as much as he does. He may tolerate the ordinary type of conversation but he holds himself aloof from any part in it and as soon as possible gets into a corner with someone to whom he can demonstrate his great store of knowledge. He is a bore.

The sporting snob is rather a harmless type and may outlive his disease. He must be doing something; tennis, golf, sailing, canoeing, horse shoes and in inclement weather he must play bridge. Activity in a physical sense is his obsession, for, if idle, there is the horrible possibility that he may have to read or be caught in the act of contemplation and reflection.

The most insidious type of the disease is manifested by the specialist snob. He is not uncommon here at Woods Hole and can be easily detected by his superior bearing towards those who are not doing his own type of work. He is interested only in his own line and speaks sneeringly of work in other fields. His friendly interest in others is shown by remarks such as "Why do you work in that subject, why don't you do something worth while." His is the most dangerous type of snobbery and the victims should be avoided, particularly by the young investigators, for there is danger of loss of confidence and of aimless wandering in the domain of research.

All of these types are in the fog—they can't see beyond a few feet from themselves; they huddle together in like groups and come to believe that the world is bounded by their special horizon. When you hear the fog horn sonorously filling the air, it is sometimes Nobska.

Let in the sun of humanity which will soon dissipate the fog. Look for something good and interesting in everybody and everything; smile and be a human being worth while. Don't be a snob!

—*G. N. C.*

THE REELFOOT LAKE BIOLOGICAL STATION

Dr. James B. Lackey

Professor of Biology, Southwestern College, Member of the Executive Committee of the Station.

Reelfoot Lake, in the extreme north west corner of Tennessee, is a large, shallow lake formed by the New Madrid earthquake of 1812. Recently the State of Tennessee has taken it over as a hunting and fishing preserve, and one of the clubhouses formerly belonging to a hunting and fishing association, together with ten acres of land, has been presented to the Tennessee Academy of Science for use as a biological station.

The station is near a small bayou tributary to the lake, and is at the end of a gravel road; the nearest village is several miles distant, but an excellent hotel adjoins the laboratory property, and workers may either camp or board at the hotel which offers special rates to laboratory people.

The building has been brought into an excellent state of repair and besides living quarters for a limited number of people will have four laboratories equipped with standard furniture and each accommodating three or four workers. Microscopic equipment, chemicals and apparatus should be brought by the individual investigator. Those desiring to work at the station should get in touch with Dr. A. Richard Bliss, Jr., President of the Academy and Chairman of the Executive Committee of the station, who may be reached at Memphis. A consulting staff has been appointed and workers may confer with such of these as are interested in their field.

The lake is nowhere very deep; there is clear water in the middle, but throughout most of its area great cypress stumps protrude above the water, and near the shore great patches of lotus and other vegetation afford food and shelter to a varied animal life. There is a border of cypress trees around the lake. A wide variety and abundance of fish, amphibian, reptile and bird life is to be found. Ecologic and taxonomic problems both in zoology and botany may be advantageously studied here, due to the richness of the flora and fauna, and the unusual life communities which one may encounter in a tramp of a mile or so from the tops of the nearby forested hills over a hundred feet above lake level, down to the marsh and the lake itself.

A STATEMENT PREPARED BY THE COMMITTEE APPOINTED TO FORMULATE AN ARTICLE FOR THE TOWN WARRANT ASKING TOWN OWNERSHIP OF A BEACH IN WOODS HOLE

In the following paragraphs is given a copy of the memorandum prepared for submission to the Board of Selectmen in connection with an article framed for inclusion in the Town Warrant, for action at the next Annual Town Meeting.

In preparing this article and this memorandum, it should be understood, *first of all, that the sole end in the mind of all its supporters is the provision of reasonable, adequate beach privileges at present and in the future for the summer and permanent residents of Woods Hole in the Town of Falmouth.*

It is true that a portion of this population, liberally estimated at a possible fifty percent., possesses private beaches, has joint rights with others in a near-by shore, or has access to the private bathing facilities of friends. But this request, its supporters have abundant reason to believe, expresses the conviction of the remaining estimated fifty percent. that its beach freedom is limited in a decidedly unfortunate manner; this belief is shared by numbers whose personal requirements are already assured otherwise,—this attitude being one in support of public welfare. Of course, the fact is that no bathing facilities have as yet been provided by the Town for Woods Hole save as it has accepted the generous offering of the Fay estate of 200 feet.

It would be a satisfaction to all interested if the Town's officers could, *at this time* (inspection at the time of the winter Town Meeting being of little value) visit the beach now used, note its condition and restrictions, and use their unbiased judgment as they contemplate this request

(An invitation to make such an inspection will be tendered the Board of Selectmen by the Committee presenting this request.)

TO THE BOARD OF SELECTMEN, FINANCE COMMITTEE, OR OTHER GROUP OF EXECUTIVE OFFICERS OF THE TOWN OF FALMOUTH, before whom this request may come:

The undersigned names are those of a group appointed by vote of a community meeting held in Woods Hole August 11, 1932, to draw up and submit an article for inclusion in the Town Warrant, for action at the next Annual Meeting.

It is the thought of this group that a few facts and circumstances leading up to this move may be informing and helpful to those concerned. We therefore submit the following items:

1. *Availability*: The Bay Shore Beach is the only one situated conveniently to a majority of those living in Woods Hole, either permanently or during the summer.

2. *Area*: Years ago through the generous courtesy of the Fay family, the entire strip of beach, some 600 feet in length, was freely used by all in the community.

Through the subdivision of this shore property and its sale in small parcels, the legal right to free use of this beach has been reduced about 65%, so that now (but again by the generosity of the Fay Estate and that of Dr. and Mrs. Meigs) only some 200 feet are left freely accessible to residents of Woods Hole or their guests. Through the courtesy of Dr. Oliver S. Strong (but only through courtesy) 64 feet more is now used, a total of 264 feet.

3. *Population*: In the meantime the number of people spending a part or all of their summer in Woods Hole has increased by several hundred, probably by 500. In round numbers, an approximation to the fact could be thus stated; while the population is three times greater than formerly the available Bay Shore Beach has shrunken to one-third its original size.

Furthermore, due to increase of stones not over one-half of the present 264 feet affords sand for comfortable bathing purposes. Not infrequently over 100 people use this area simultaneously, three quarters of them huddled onto the sandy end. Recently one of our group counted 97 people at 5:30 P. M. Two years ago, fully 300 people occasionally used this beach at one time.

4. *Responsibility*: It is felt that no one is blameworthy for the present circumstances. It would indeed have been fortunate if the Town of Falmouth had appropriated this beach at once when the Fay Estate decided to release the property; but at that time no such growth of the community, stimulated in part by an unexpected enlargement of the Marine Biological Laboratory, was predictable.

5. *Preparation of Petition*: Feeling the urgency of the situation an informal meeting of those specially interested was called, and a special committee of five with Professor Caswell Grave elected as chairman, was delegated to look into all obvious aspects of the situation, confer with those owning property on the Bay Shore Beach or nearby, investigate the question of private and public rights and other related matters. Their report was submitted at an open community meeting, notice of which was spread to people in the community several days ahead, by word of mouth and

(Continued in Woods Hole Log section: Page 244)

The Collecting Net

A weekly publication devoted to the scientific work at Woods Hole.

WOODS HOLE, MASS.

Ware Cattell .... Editor

Assistant Editors

Annaleida S. Cattell Vera Warbasse

Contributing Editor to Woods Hole Log
T. C. Wyman

The Last Number

This number of THE COLLECTING NET is four pages larger than usual. The next,—the last issue for the season,—will contain still more extra pages. If it turns out feasible, we plan to include very brief summaries of all the research papers which are scheduled to be given at the general all-day meeting on Friday, September 2. This arrangement would probably involve a delay of several days in bringing out the number.

The Laboratory and the Beach

The following seemingly unrelated statements are not without interest:

(1) Last September the Executive Committee of the Marine Biological Laboratory went on record as being opposed to the Laboratory taking any part in the discussion on the beach question.

(2) In July of this year the Executive Committee again decided that the Laboratory should take no part whatever in the beach discussion.

(3) Last Monday evening Dr. Gary N. Calkins gave a talk before the Rotary Club in Falmouth. He departed from the subject of his lecture long enough to express his opinions on the beach question. We believe that there were members of the audience who understood him to state that the more influential people at the Marine Biological Laboratory were opposed to town ownership of a beach in Woods Hole.

(4) Dr. Calkins is a Trustee of the Marine Biological Laboratory and is secretary of its Board of Trustees. Last year he resigned his position as clerk of the Corporation—a position which he had held for a great many years. He has often served on the Executive Committee.

BOOK REVIEWS

Last year an investigator initiated the plan which he had suggested the previous Fall for reviewing books. He offered to obtain reviews for THE COLLECTING NET providing all the books received from the publishers for this purpose were turned over to the library of the Marine Biological Laboratory. This plan worked very well and THE COLLECTING NET and the library are under great obligation to this individual for the many valuable reviews that he obtained.

He was unable to give the required time to this work again, and the gap that he has left is evident if one compares the number of book reviews which we had the privilege of printing last year with the relatively few of this season. He found, as we have done, that obtaining worthwhile reviews is a time-taking task.

This Spring we learned that a number of investigators felt that if they gave their time to reviewing a book that they ought at least to be "paid" by being allowed to keep the books. They wanted to give them to the library, but it seemed to them that poorly paid investigators deserved the books more than an endowed institution. Therefore, we have adopted the policy of giving the book to its reviewer.

We have been severely criticized for not continuing to give review copies to the library. We consider this criticism unjust. It is difficult to obtain a good review of a book. That burden is lightened if the person who is asked to review the book knows that it will become his property. Even the gift of a copy of the book that he reviews is meager pay. Any arrangement which will make it possible to increase the number and worth of the book reviews in THE COLLECTING NET is not only justified but essential from the editorial point of view as well as from the standpoint of the publishers who have a right to expect reviews of merit.

CURRENTS IN THE HOLE

At the following hours (Daylight Saving Time) the current in the hole turns to run from Buzzards Bay to Vineyard Sound:

Date	A. M.	P. M.
Aug. 20	7:38	8:02
Aug. 21	8:21	8:47
Aug. 22	9:05	9:36
Aug. 23	9:51	10:28
Aug. 24	10:42	11:24
Aug. 25	11:38	——
Aug. 26	12:22	12:34
Aug. 27	1:18	1:29
Aug. 28	2:12	2:22

In each case the current changes approximately six hours later and runs from the Sound to the Bay. It must be remembered that the schedule printed above is dependent upon the wind. Prolonged winds sometimes cause the turning of the current to occur a half an hour earlier or later than the times given above. The average speed of the current in the hole at maximum is five knots per hour.

ITEMS OF INTEREST

THE OFFICIAL MEETINGS OF THE MARINE BIOLOGICAL LABORATORY

The annual meeting of the Trustees of the Marine Biological Laboratory was held on Tuesday, August 9.

Dr. T. H. Morgan and Dr. H. B. Goodrich were elected to fill the vacancies which occurred in the Executive Committee by the expiration of the terms of Dr. A. C. Redfield and Dr. W. C. Curtis. This committee now consists of the following individuals:

Edwin G. Conklin................Class of 1933
Charles Packard..................Class of 1933
H. B. Goodrich....................Class of 1934
T. H. Morgan......................Class of 1934
M. H. Jacobs ....Ex-Officio
F. R. Lillie ....Ex-Officio
Lawrason Riggs ....Ex-Officio

Thirteen investigators were elected to membership in the Corporation:

P. B. Armstrong	J. M. Johlin
L. G. Barth	G. de Renyi
R. H. Cheney	A. E. Severinghaus
K. C. Cole	L. B. Sayles
B. R. Coonfield	R. M. Stabler
R. B. Howland	C. H. Taft, Jr.
S. H. Schrader	

The nominating Committee (appointed by the Trustees) consisting of Dr. Gary N. Calkins, *chairman*, L. V. Heilbrunn, Leigh Hoadley, H. H. Plough and A. C. Redfield, brought in the following nominations which were approved by the Board:

Vacancies		Cause of Vacancies	Nominations
Treasurer	L. Riggs	By Expiration	L. Riggs
Clerk	C. Packard	of Term	C. Packard
Trustee, 1932	R. Chambers	"	R. Chambers
" "	W. C. Garrey	"	W. C. Garrey
" "	C. Grave	"	C. Grave
" "	M. C. Greenman	"	M. C. Greenman
" "	R. A. Harper	"	H. B. Bigelow
" "	A. P. Mathews	"	A. P. Mathews
" "	G. H. Parker	"	G. H. Parker
" "	C. R. Stockard	"	C. R. Stockard
" 1934	M. M. Metcalf	Resignation	F. Schrader
" 1935	H. G. Bumpus	Retirement	W. C. Allee

The replacements made were necessary because Drs. Bumpus and Harper had reached the age limit of seventy, and Dr. Metcalf no longer wished to serve on the Board. These three men were nominated for the class of Trustee Emeritus.

In accordance with the change in the By-laws the meeting of the Corporation was called for 11:30 A. M. instead of 12:00 N. The group elected all of the men nominated without comment. In fact, the non-trustee members of the Corporation adhered to the time-worn custom of saying nothing but "I." That they did very well.

Dr. E. C. McClung, Professor of Zoology at the University of Pennsylvania, carried on his research work this summer at the Rocky Mountain Biological Laboratory (near Crested Butte, Colorado) until August 1. He is now continuing his work at the University of Colorado in Boulder.

Dr. and Mrs. Winterton C. Curtis sailed August 8 from Los Angeles to Honolulu. After a short visit there they will go to Tokyo, Japan. Dr. Curtis is to deliver lectures on subjects of general biological interest at the Keio School of Medicine in Tokyo during the coming year.

Miss Suzanne Smith sailed August 11 from Los Angeles to Tokyo where she will continue her work with Dr. Curtis. Last Spring Miss Smith received her Master's degree at the University of Missouri and was appointed instructor in zoology at this institution.

Dr. Karl Sax, of the Arnold Arboretum drove down from Cambridge on Friday to take Dr. C. D. Darlington and his bride back with him as his guests.

The M. B. L. Club is very much indebted to Mr. Nicol, the florist, for being so kind as to furnish the Club with flowers for the Saturday Night Dance held on August 13. The flowers were remarked upon by many for their beauty and fragrance, and they contributed much to the success of the party.

WOODS HOLE LOG

(Continued from Page 237.)

by notices posted prominently on the Bulletin boards in the Woods Hole Post Office and at the Marine Biological Laboratory.

Procedure thus leading up to the present message to you has been orderly, unhurried, and open to the entire community for thought and discussion. The petition herewith presented as an article for insertion in the Warrant was given a clear majority vote of 30 in favor to 18 against (See Collecting Net issue of August 13). Over 100 were in attendance at this meeting.

6. *Other Plans suggested*: At the Community Meeting on August 11th, four plans of action were submitted by the committee mentioned in the preceding section. The plan adopted and embodied in the Article suggested for inclusion in the Town Warrant was *Plan* 4. Three other plans were briefly as follows:

PLAN I

That a Woods Hole Bathing Beach Society be organized, which shall assess annual dues, the income from which shall be used to maintain the raft, keep the beach clean and orderly, and perhaps maintain a life-guard at certain hours,—all this in co-operation with Dr. and Mrs. Meigs, the present owners of Lot X.

This plan was rejected by a vote of 18 in favor to 34 against.

PLAN II.

That the Town of Falmouth at its next regular meeting be requested to take such steps as may be necessary to acquire possession of Lots X and 6; to appropriate such sums of money as may be required to so improve the beach on these lots that its entire extent is made suitable for the legitimate and usual purposes of a bathing beach; these improvements to include the construction of a jetty; the removal of stones from the beach, and moving the bath-house to a more suitable and convenient location on Lot X, and that this beach be legally reserved for the exclusive use of the permanent and summer residents of the Town of Falmouth.

Rejected by a vote of 2 for and 39 against.

PLAN III.

That the Town of Falmouth at its next regular meeting be requested to take steps necessary to acquire possession of Lot X in entirety, including the bath-house and the strip of beach on Lots 3 to 6 from low water mark to the stone wall (extended) now standing and that this beach be legally reserved for the exclusive use of permanent and summer residents of the Town of Falmouth.

This plan was rejected by a vote of 3 for to 37 against.

7. *Reasons for Action Now*: Aside from present overcrowding of the unrestricted area other reasons for early action are:

(a.) At present only two cottages abut on the strip of beach asked in this petition.

(b.) Rights in front of these properties can be secured at less expense now than at a later time after the owners may have spent larger sums on their land or buildings.

8. *Improvements and Expense*: The petition adopted at the Community Meeting specified that the town would be asked for additional space only at this time,—no improvements being urged. This was favored, in part at least, because it was felt that not more than necessary should be asked when financial demands on the town may be larger than sometimes, and its income less certain.

The fact should not be unmentioned however, that this beach has been becoming increasingly stony in late years, and at some future time it may become necessary to petition the town for help in its improvement in a manner similar to that successfully employed at Falmouth Heights.

9. *A Community,—not a limited party or group Interest*: Finally, may we point out that this is not a petition from any special party; particularly do we mention that it is not sponsored by the Marine Biological Laboratory as such. It is submitted, as you will see, by a very considerable number of people, — permanent residents, and many others who make Woods Hole their place of work or vacation during the summer.

Opposition to the petition is natural and expected; the request however is submitted by people who feel that the general public should be protected in its reasonable expectation of shore privileges. We sincerely regret that the pleasure and rights of anyone may be usurped or injured if this petition is granted; but it seems that such injury would be much less now than it might become at a later date. Such a concession while somewhat injuring the property of five owners will bring legitimate pleasure to hundreds.

To the Honorable Board of Selectmen
Falmouth, Massachusetts.

Whereas, the undersigned residents and voters or taxpayers of the Town of Falmouth, located in Woods Hole, are of the opinion: That the beach used for bathing purposes at Bay Shore, Woods Hole, is so restricted as not to accommodate the number of permanent and summer residents who should be entitled to use the same.

Now therefore, we respectfully petition the Board of Selectmen that there be inserted in the Town Warrant of the Town of Falmouth for action at the next Annual Town Meeting, an article substantially as follows:—

That the Town of Falmouth acquire by purchase, or taking, or otherwise, at the Bay Shore Beach, so-called, at Woods Hole, that strip of beach located between the waters of Buzzards Bay

(Continued on Page 248.)

(Other pages of the Woods Hole Log will be found on pages 246 and 248)

WOODS HOLE LOG

DR. GOLDSCHMIDT TALKS ABOUT GERMANY

Dr. Robert Goldschmidt, member of the Kaiser Wilhelm Institute, Berlin, spoke at the Sunday Penzance Forum on "The Present Political Situation in Germany." Clear and to the point always, he gave an unbiased account of the puzzling situation over there.

Dr. Goldschmidt briefly summarized the political history of Germany during the past thirty years, explaining the socialist revolution, the treaty of Versailles, the period of inflation and the depression that followed. The Social Democrats who were the party in power at the time were held responsible for Germany's downfall and humiliation. To offset this a movement was formed which was only for the "Vaterland," and was not imperialistic. Its adherents were the bourgeousie, the cultured intellectual class who had lost everything they owned.

The second group were the "youth" who had been through the agonies of the past war period. They had no joy, no future, and they believed that their misery was caused by those who wrote the Versailles treaty.

Hitler attracted these two disillusioned groups to him. He is not an intellectual but is an extremely clever propagandist. He gave the youth an ideal patriotism and nationalism not one of monarchism. He promised to re-create a powerful Germany, to do away with the politicians, and to get a powerful central government. The principles of his party, which officially is called the "National Social Workingmen's Party," were state socialism versus private property and capitalism. Hitler organized the army purely for show, to please the people by parades and uniforms. He also used it to protect public meetings and to keep down rowdyism.

There must be a great charm and personality to Hitler for already forty per cent. of the German voters are Hitlerites; eighty per cent. of the youngsters from twelve to twenty-five and most of the intellectuals follow him.

Dr. Goldschmidt then turned his attention to the last elections. The main feature was the growth of the Hitlerites. Ex-chancelor Bruening is by far the best political mind in Germany. He has been the able leader of the Catholic, or Centrist, party. However, Hindenburg felt that the best way to stop Hitler was to substitute for Bruening's leadership a conservative non-partisan ministry. Therefore he asked Von Pappen to be chancellor. Hitler has been asked to join this cabinet for they felt that if he could be forced to share the responsibility, he would no longer be in the strategic position of "the opposition," but would have to assume joint responsibility. He would not be able to carry out his extravagant promises and he might be shown up as the real political charlatan that he is.

The speaker modestly admitted that his opinions of the present situation might be wrong and that Hitler might do something surprising: "Just read the papers and you yourselves may be able to figure the outcome."

Few questions were asked from the hundred-odd people present, possibly because Dr. Goldschmidt's discussion was so clear and explicit that there was nothing more that could be added.

—*V. W.*

AN ACCIDENT AT THE MARINE RAILWAY

On July 30 an unfortunate accident occurred at the marine railway of the Marine Biological Laboratory. Witnesses described the incident as follows: At a few minutes after six o'clock in the evening Mr. Alfred M. Hilton removed the pin which allowed his motor boat, that had been undergoing repairs, to coast down the track and plunge into the water. It dashed into a lightly built tender, smashing its side, sending its single occupant into the ocean. Fortunately the water was only a few feet deep and the old man was able to extract himself from the debris in which he found himself and make his way safely to the shore. Although suffering from shock and a badly scraped hand, he was remarkably calm and deliberate. His hand was temporarily dressed with the first aid kit in the Laboratory carpenter shop and then he was quickly driven to Falmouth where Dr. Tripp dressed the wound. He was then rowed out to his luxurious catboat anchored in the middle of Eel Pond where he was able to change his dripping clothes.

The old man turned out to be Captain A. E. Harding who is a disabled world-war veteran. He was Lieutenant-Commander of the *Leviathan* during the war until he was permanently injured by a torpedo explosion. Before the war he had been Captain of Mr. Vanderbilt's vessel which has taken many scientific cruises.

Those who saw the accident believe that the owner of the railway was responsible for the accident. It is true that its employee could not see the skiff when he started the boat down the inclined tracks; it is also true that it is safer not to row over the tracks of a marine railway, even in the evening. However, Captain Harding was on "navigable waters" and therefore had every legal right to be where he was at the time of the accident.

(Other pages of the Woods Hole Log will be found on pages 244 and 248)

WOODS HOLE LOG

THE MACONIKEY INCIDENT

There have been many rumors going around Woods Hole about a party of young people who went on a picnic at Maconickey Heights on Marthas Vineyard. The facts are placed on record here: Four sailboats, holding eighteen young people sailed over to Maconikey a week ago Wednesday. After picnic supper they went up to the old hotel, which has been deserted for ten years, for the purpose of playing "murder" in a "haunted" house. The young people had horns and managed to make a great deal of noise. Contrary to the rumor that they broke everything in sight practically demolishing the building, they upset a telephone booth, broke six window panes, messed up a box of post cards, broke off a board barrier which was across some stairs and banged up and down some iron beds doing no harm to them at all, only making more noise.

When the party returned to the beach a state trooper was there and took the names of its members. The boats then sailed home all returning before midnight. On Friday the owner and his lawyer pressed charges for $700.00 threatening criminal prosecution if the amount was not immediately paid. Not desiring to go to court the young people handed over the required sum. After the news of this event became known, a Boston reporter inquired of the owner what he would sell the property for; the owner replied $700.00. The reporter then called on the owner's lawyer and asked how much damage had been done, and was informed that it did not amount to more than $50.

These picnickers have all learned a lesson to respect other people's property and they hope that others will also profit by their experience.—*V. W.*

The steamer *Nantucket*, which had its bow smashed when it collided with its sister ship, the *Marthas Vineyard*, returned to its regular run last Wednesday.

Although the *Marthas Vineyard* was put back in service shortly after the accident, she has now been sent to Quincy for further repairs. At the time of the mishap temporary repairs were rushed so as to have as little interruption of the schedule to the Islands as possible, but now the *Marthas Vineyard* is to be put in shape for her winter service between the Islands and the mainland.

—*T. C. W.*

Friday, August 19, at the home of Mrs. Geoffrey G. Whitney, Little Harbor Farm, Woods Hole, there was an all day exhibit and sale of articles representing the handiwork of the blind.

The Woods Hole Yacht Club has had a series of "bad breaks" in trying to hold its annual cruise. Last Thursday the weather was bad and the cruise was postponed a day. To all appearances Friday seemed to be the perfect day. At noon the smaller boats started to race from Woods Hole to the Weepeckets; from there they were going to continue to Quick's Hole which is at the further end of Naushon. However, a bad wind arose causing such high seas that many of the boats could not make any headway and were in danger of being swamped. Most of them were taken in tow and safely taken into Hadley Harbor. The others were turned back and just as the last boat reached safe waters a terrific thunder storm broke. After it had let up a bit the boats were towed home and the cruisers spent a comfortable night in their own beds. It is hoped that the Club will hold a cruise before the summer is over, for such a sojourn is exceedingly popular among the younger members. Next Thursday there will be a treasure hunt under the auspices of the Yacht Club and made up by Mrs. J. P. Warbasse. —*V. W.*

The Coast Guard has received a letter from the Beverly Yacht Club of Butler's Point, Marion, Mass., asking for a boat to patrol the Yacht Club races for the Sears Bowl, on August 29. It is anticipated that quite a large number of spectator and excursion boats will attend these races since the Sears Bowl is emblematic of the Junior Championship of the Atlantic Coast. The Coast Guard has accordingly promised to send a boat.

—*M. L. G.*

Mr. Goffin of the Bureau of Fisheries has recently returned from a collecting trip in the new *Phalarope II* with Dr. Parr from the Bingham Oceanographic Laboratory at Yale. The new boat is working very well although it needs a little seasoning to put it in perfect condition.—*M. L. G.*

THE BEACH QUESTION

(Continued from page 244)

and the stone wall now standing in front of Lots 3 to 6, inclusive, as shown on the plan of Bay Shore Lots, thereby acquiring about 280 feet of beach North of the Lot X bathing beach, said strip of beach to be used for a proper municipal purpose; that provisions or regulations be made so that the use of this beach shall be exclusively reserved for permanent and summer residents of the Town of Falmouth; that legislation be obtained if needed; that a sum of money be raised and appropriated for said purposes; and that the proper authority be given the Board of Selectmen to carry out these matters; or act anything else concerning the same.

(Other pages of the Woods Hole Log will be found on pages 244 and 246)

THE COLLECTING NET

Vol. VII. No. 10 SATURDAY, AUGUST 27, 1932 Annual Subscription, $2.00
Single Copies, 25 Cts.

CYTOPLASMIC STRUCTURES CONCERNED IN THE DEVELOPMENT OF THE EARLY EMBRYO

Dr. A. R. Moore
Professor of General Physiology, University of Oregon

The theme of my talk as announced is on the results of development without membranes in Echinoderm eggs. This has a number of ramifications and relates to the comparatively simple fact that has been noticed by other investigators, namely, that if no membranes are present the cells do not follow their normal course but form bizarre groups and tend to fall apart. This I have found to be the case with four or five different Echinoderms in this country and in Europe.

In its more general aspects, the problem before us is to determine the part played by membranes and cytoplasmic connectives in the mechanics of the development of a multicellular animal from one cell. It is instructive to consider a plasmodium. These simple animals in dividing give rise only to similar cells, i. e., each daughter cell is exactly like the mother cell. If the plasmodium is filtered through (*Continued on Page 262*)

M. B. L. Calendar

TUESDAY, AUGUST 30, 8:00 P.M.

Seminar: Dr. A. W. Pollister: "The Development of Leucopoietic Tissue in Amblystoma punctatum".

Dr. W. H. F. Addison and Dr. Doris A. Fraser: "Pigmentation in the Hypophysis and Parathyroids of the Gray Rat".

Dr. George F. Laidlaw: "The Dopa Reaction and the Problem of Pigment Formation in Mammalian Skin".

FRIDAY, SEPTEMBER 2

General Scientific Meeting: Session beginning at 9:00 A. M., 11:00 A. M. and 2:00 P. M. Full program will be found on page 297.

GENETICS AND DEVELOPMENT

REYNOLD A. SPAETH MEMORIAL LECTURE

Dr. Richard Goldschmidt
Kaiser Wilhelm-Institut für Biologie

It is one of the sad privileges of men advancing in age to be eligible to the honorable task of delivering lectures dedicated to the memory of a much younger friend whom fate has not permitted to fulfill the great expectations held for him by those who knew him best. In accepting the honor to deliver this memorial lecture, I quite naturally recall the Woods Hole days sixteen years ago, when Reynold A. Spaeth was one of the few with whom I used to discuss certain questions which then were uppermost in my mind. The selection of this evening's topic is therefore influenced by these recollections. During the summer 1916 I had the honor to deliver right here in the old lecture hall an evening lecture, in which I tried to explain the experimental results of my work on intersexuality, a term which I had introduced only a year before. I proceeded then to derive from the facts a general theory of sex-determination, which I had developed since 1911 but which had not yet come to be known in this country, a theory which

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nowadays is called the theory of the genic balance of the sex genes. At the end of this lecture I hinted with a few words at further consequences of the analysis of intersexuality. According to the printed report in the *American Naturalist* of 1916[1], I said: "Very important new facts will be published later which will probably enable us to replace the symbolistic Mendelian language, used here, by more definite physico-chemical conceptions." And further: "I am rather optimistic in regard to the general conclusions which might be drawn from these facts, as well as regards the sex-problem as on some fundamental questions of heredity. Combining these facts with the work on hormone action as related to sex, we can, I think, form a pretty clear idea about sex differentiation and determination. If we put them in line with the facts of experimental embryology concerning the determination problem we see the outlines of a promising theory of heredity."

During the many years which have since passed, I have tried to formulate the conclusions at which I hinted then, and to find new experimental evidence on which to base them. And still after much thinking on the subject I stand by the words quoted from 1916, namely: "I am rather optimistic in regard to the general conclusions, etc." The more facts are being accumulated and the more I try to coordinate them and to see a simple guiding idea behind their diversity, the more I am convinced that my method of general approach, which has been highly praised by some and severely criticised by others, is the only one which leads to a deeper insight into the process of heredity. This then is the reason why I have not chosen to present here today some of my recent experimental work, but rather to continue some of the general reasoning from the point where I had left it in my lecture of sixteen years ago.

The decisive step in the analysis of intersexuality, which geneticists often found difficult to understand though physiologists were usually willing to accept it, was that step which led from the static Mendelian analysis of the problem to the dynamic viewpoint of the physiology of development. Here then is found the natural point of departure for our discussion. The limits of ordinary Mendelian analysis, as known at that time, were first reached when it was shown that the experimental facts regarding intersexuality could be expressed not by a simple Mendelian formula, but only by assuming that two genes or completely linked sets of genes[2], those for femaleness and maleness, controlled the result according to their quantitative relation or balance. The simple Mendelian formulation was thus enlarged by a new conception, namely that of a quantitative relation or balance of genes working together towards the production of a phenotype, the character of which was in some way proportional to that quantitative relation of the genes in question—or in other words, their amount of balance or unbalance. This new conception, which had to be added to the general Mendelian formulation and which had given me the clue to the whole analysis already at the beginning of the work between 1911 and 1914[3], could still be expressed in the old Mendelian language, if the gene in favor of which the balance acted was called epistatic to the other and if the different degrees of this balance, to which corresponded the sexes and the different types of intersexes, were expressed in terms of degrees of epistasis, which might be measured by some unit. Thus the formulae with numerical values of the genes, symbolizing the grades of their effect, had to be introduced. It took many geneticists a long time to understand this.

But still another extension of Mendelian language was necessary to cover the facts. If the different amounts of the unbalance of male and female genes were to stand for the normal sexes as well as for the different degrees of intersexuality it followed necessarily that a certain minimum value of this balance had to exist below which one of the pure sexes was determined, and another maximum value, above which the other sex was determined, the intersexual stages lying between. These limiting values for the balance of female and male genes were accordingly called the epistatic minimum, a term which again meant a necessary extension of ordinary Mendelian conceptions, in order to describe the experimental facts still in the language of static Mendelism. This was the point reached in 1912, a point which was situated at the utmost limits of purely Mendelian conceptions. This became clear when the fact was considered that there existed two completely different types of intersexes, namely male and female intersexes, which replaced in the respective experiments the gametic males or females. Now the Mendelian formulation which had covered the case thus far by the introduction of the principle of genic balance and of the epistatic minimum could describe adequately the production of a series of intersexes between the two normal sexes, that is the two limiting minima, but it could not explain why the same ratio between

1 Experimental intersexuality and the sex-problem. "Am. Nat." 50, 1916.

2 The problem whether only individual sex-determiners or a completely linked group of such are involved in our case, has been repeatedly discussed, e. g.; Untersuchungen uber Inter-sexualitat V, "Zs. indukt. Abstl." 56, 1930; Analysis of Intersexuality in the Gipsy moth. "Q. Rev. Biol." 1931.

3 The whole literature on the subject is found in the author's book: "Die sexuellen Zwischenstufen" J. Springer, Berlin, 1931; further in the paper quoted in foot-note 2.

male and female determiners, say the one midway between the ratios for the normal sexes, determined in one case a medium grade female intersex, and in another case the completely different medium grade male intersex. Here then was the point at which the power of static Mendelism ended and further progress was only possible by the transition to a dynamic point of view; in other words, the genetic explanation was to be followed by one based upon the physiology of development.

This step to which I had hinted in the previously mentioned evening lecture given here at Woods Hole, could be taken when it was found what these intersexes really were. It became apparent first in 1916 (and as a matter of fact I do not understand now why I had missed this point in the preceding years) that in a series of intersexes connecting the two pure sexes step by step, such organs which are the last to differentiate in development are the first to assume the character of the opposite sex in the case of low grade intersexuality, and that, *vice versa,* the organs which are the first to differentiate in development are the very last to change towards the other sex in high grade intersexuality. From this rule it followed that intersexes are to be considered as individuals which have begun their development as of one sex up to a certain turning point and have finished it as of the opposite sex after the turning point[4]; further that male intersexes begin as males and end as females and that female intersexes begin as females and end as males; and further that the different grades of intersexuality are a function of the position in time of the turning point; earlier turning point—higher grade of intersexuality. This solution which I also had the pleasure to announce first in this country, namely, at the 1916 meeting of the American Association, has meanwhile been tested by extensive embryological study and found to be an actual fact. It opened now the way to the solution of the whole problem by connecting a definite embryological process with a definite genetic condition.

The situation was this: on the genetic side we had first a gene or genes for maleness, second a gene or genes for femaleness and both in a series of different conditions, found in different races; further we knew that the phenotypic effect of these genes, namely, maleness, femaleness and all degrees of intersexuality, was proportional to the amount of balance or unbalance of these genes. On the embryological side, we had the occurrence of the turning point for sexual differentiation at a definite time, and combining now the genetic side with the embryological side, we were facing the fact that a series of increasing values for the unbalance or abnormal ratio of the sex genes has its effect in a series of corresponding changes in the time of incidence of the turning point, which occurs earlier and earlier. Here then was an opportunity to connect the action of definite genes, present in different ratios, with an embryological event, occurring at definite and proportionally different times. Whereas we have genes for both sexual differentiations simultaneously present, and whereas the control of actual sexual differentiation belonged first to one and later to the other gene or set of genes, and whereas this control changes at a definite time, which is conditioned by and proportional to the unbalance or ratio of these genes, there is left only one way of linking these facts together; namely, by concluding first, that the genes in question are producing each independent chains of reaction which lead at a certain threshold to the production of the something which controls sexual differentiation; second, that the amount of unbalance of the two genes or their ratio results in corresponding different velocities of the two chains or reaction; third, that the reaction of higher velocity controls the sexual differentiation; and fourth, that the turning points therefore must be the points at which this control changes, which means graphically points of intersection of the two respective curves of reaction. Standing in this place here I cannot help recalling Jacques Loeb's excitement when I told him this story and some of the consequences regarding a general theory of heredity. I have since discussed this point with other great physiologists who agree with me that there is no other way of representing the actual facts from a dynamic point of view. Thus I concluded that here a case was found in which the action of definite genes could and had to be interpreted in terms of speed of reactions and that it might be possible to base a theory of genic action upon this interpretation. Also this conclusion I had the pleasure to announce in this country at the said 1916 meeting of the American Association.

There was also another conclusion which had to be drawn from the same facts, and with this we are getting into deep waters. The phenotypic result (male, female, male intersex, female intersex of any grade) was found to be dependant upon a quantitative relation, balance or ratio of male and female sex genes, and the genetic results showed and have ever since shown that only one female and one male gene are involved. But of each of these sex-genes a considerable number of conditions, in genetic language of multiple allelomorphs, were found which gave typical but different effects. These conditions, which proved to be absolutely constant in all experiments in-

[4] As a matter of fact, Baltzer had found already two years before the same for the intersexes of Bonellia, a fact which had escaped me for a long time.

volving the same genes might be termed the strength of action, or the potency or the valency of these genes, and thus the phenotypic result in regard to sex was dependant upon the relative valencies of the female and male determiners present at fertilization. Then it turned out that one of these determiners, namely, the one for maleness, was situated within the X-chromosome, the other one for femaleness, being outside the X-chromosome. This meant that the always constant genes for femaleness were faced either by one or by two genes for maleness. Thus on one hand, the genotypic effect was produced by the relative valencies of the two types of sex-genes; on the other hand, two of the possible phenotypes, namely the pure sexes, were dependant upon the ratio between the always constant female genes and the male genes present in one or two quantities. In these limiting cases, then, the pure sexes, the relative valencies, responsible for the phenotype, were obviously identical with relative quantities of these genes. But the normal sexes were only two points in a continuous series of sexual conditions, all dependant upon different relative valencies of these genes. The conclusion therefore was not only logical but also inevitable that all the other conditions for the sex-genes, their different degrees in strength or valency were also in reality differences in their quantity. Thus the quantitative relation or balance of these genes finally was resolved into the ratios of actual quantities. And the former conclusion which showed that the sex-genes acted through chains of reaction of different but typical velocities could now be enlarged by the addition that the speed of these chains of reaction is proportional to the quantities of the genes in question.

It is a strange fact that this conclusion was regarded by some orthodox geneticists as a most condemnable heresy. To be sure they could not give a different explanation of the facts and they could not contest the logic of the analysis. Therefore they simply declared it to be inadmissible—this word has actually been used—to assume that a gene may have a definite and fixed quantity as one of its properties and that the effect of a gene might be in some way proportional to its quantity. In our object, there was no possibility to demonstrate visibly such a difference in quantity, because in our case everything happened within the normal diploid number of chromosomes. But some experiments have since been performed with our material, besides the visible demonstration in triploid intersexuality, discovered by Stanfuss and since analyzed in moths and in Drosophila. Our experiments in question demonstrate clearly the logic and the soundness of the conclusions[5]. To mention only one: two X-chromosomes and therefore two male genes (in the case of female heterogamety) are determining the male sex. If, however, I combine female determiners coming from a strong race, that is genes of high valency, with the two X-chromosomes derived from races of very low valency of the sex-genes, the resulting individual will be a female in spite of its two X-chromosomes. By appropriate crosses I might now build up individuals which contain the same strong female determiner as before, one X-chromosome with the very low male determiner as before but the other X coming from a race with a little higher grade of valency of the male determiner. The individual thus composed will be a little more male than before, and this is a high grade intersexual male, very near to complete transformation into female. Now I continue replacing the second X-chromosome by one derived from a still stronger and stronger race; correspondingly, the individual in question will be less and less intersexual, so that when a certain combination is reached it will be a normal male.

The following table gives an actual experimental result. Now this experiment and its easily imaginable variations show that the action of the two male genes which are present in any case is proportional to the sum of the valencies of the two genes. As a matter of fact we ought to be able to calculate from a series of such experiments the relative valencies of all these genes in some arbitrary units, because these experiments furnish a number of equations which may be solved. Thus we have a number of differently active genes and any two of them act together always in proportion to their sum. I can draw from this no other conclusion but that it is the quantity of the thing in question which determines its action.

I have never been able to understand why this conclusion which safely rests on experimental facts, has been considered by some as offensive. The number, the size, and the shape of the chromosomes are constant; the size of cells is constant and often their number in a given organ; the number and size and arrangement of blastomeres are constant, the number of segments, of bristles, and I know not what else. Orderly development of a given organism requires a wonderful amount of quantitative constancy from the organ down to the chromosome. Why then should exactly that bit of substance which after all is responsible for all the rest be required to produce its wonderfully typical action of an unique sameness on the basis of a negligible quantity? To my mind, even apart from all the evidence produced, the first requirement for something like an understanding of the action of a thing like a gene, would be its presence in typical quantity at the onset, because the mass of a reacting substance is always the first variable to be considered. If in addition, the facts reveal such a simple relation as that between the quantity

5 Details are found in: "Untersuchungen uber Intersexualitat" I-V. "Zs. indukt. Abstl." 1920-30, see especially Nr. V.

of the reacting gene substance and a corresponding velocity of reaction, I am ready to consider this as a fundamental insight, upon which one ought to be able to build a theory of the genic action, a theory of heredity.

I have tried now to show how step by step the results of my experiments forced me first to stress the purely Mendelian conceptions by introducing the idea of genic balance and of the epistatic minimum and then to go beyond the limits of static Mendelian conceptions towards the goal of a dynamic understanding of a gene-controlled determinative process. The next step to take was naturally to try to apply the fundamental conceptions to the elaboration of a general theory of heredity, based on the principle of coordinated reaction velocities, as announced in my lecture here sixteen years ago. It is only recently that I learned[6] that a few years before I had derived my conclusions and had embarked upon their generalization, Professor M. F. Guyer had already arrived at a similar conception which, though no experiments were available at that time, was developed by him in a very ingenious way. I am glad to make use of this occasion to pay my respects to Professor Guyer's intuition and to quote some of his sentences, namely:

"If in the comparatively simple cases of associated simultaneous reactions with which we are acquainted in non-living matter, relative velocities may so modify the results, we can readily realize of what tremendous importance regulation of this matter must become in living protoplasm where doubtless vast numbers of chemical reactions and interactions are going on at the same time. In fact, could we locate such a time-regulating factor in the germ-cell it would seem that we had accomplished a long stride toward an understanding of the controlling and coordinating mechanism which insures the appearance of just the proper substance at the right time in morphogenesis. It would constitute a qualitative as well as a quantitative regulator, for by determining quantity at any given time it determines what the next chemical reaction will be, and hence in the very doing of this, it necessarily conditions the chemical outcome of that reaction."

There can be no doubt that these sentences contain already the essence of the theory of the orderly arranged, interwoven and balanced velocities of reaction. Returning now to the further development of my own work, I obviously continued arguing the following way: determinative processes in regard to sex have to do with almost any type of morphological and physiological differentiation occurring in development. If, for example, we turn our attention to a single organ like the genital armature in insects, which exhibits differences in the two sexes, of a degree, which might be compared to the differences in structure of two far distant organisms, we realize the amount and diversity of specific differentiation which may be brought about by such a simple system of coordinated reaction velocities as that which had been actually demonstrated. And if we include in this deliberation all the complex forms of one and the same organ which are obtained in a thoroughly orderly fashion in case of intersexuality, which means in consequence of a change in the coordination of the system of reaction velocities, we come to the conclusion that a similar conception ought to be applied to all types of morphogenetic processes, that is, to development in general. Development ought to be disentangled into a series of coordinated reactions of definite velocities, producing at a certain threshold a certain event, say the appearance of embryonic hormones or of determining stuffs, thus securing the order and seriation of developmental processes. And just as in the intersexuality experiments the genes in question controlled the respective speeds of reaction, so in normal development would the genes also control the speed of reactions with which they are concerned. Expressed more specifically, the genes must be things which produce their typical effects by catalyzing chains of reaction, the speed of which, *ceteris paribus*, and given the specific substance of each gene and the plasmatic substratum, is proportional to the quantity of the gene and therefore fixed within the entire system of simultaneous coordinated reactions of different speed[7].

We have tried since to demonstrate in detail how such a system accounts not only for numerous genetic facts, but also for facts of experimental embryology; and indeed even sheds light on evolutionary questions. I shall not try now to develop these conclusions, as it is my intention this evening to discuss in the first line the experimental and logical basis of the whole argument. The principle will moreover be visible incidentally if I continue relating the actual sequence of findings which helped to shape these ideas. The different sex genes of typical valency or quantity behaved in the experiments as a series of multiple allelomorphs, of which 8-10 members have been isolated by now[8]. Simultaneously I was studying another series of multiple allelomorphs which permitted the analysis of the effects of the genes within this series in a dynamic way, because the effect of these genes became visible in the larvae

6 Guyer, M. F.: The germinal background of somatic modifications "Science" 71, 1930.

7 These views and their consequences have been developed in: Die quantitativen Grundlagen von Vererbung und Artbildung. "Roux's Aufs. Vortr. Entw. mech." 24, 1920; A more detailed account, leaving out the evolutionary side, is found in: "Physiologische Theorie der Vererbung." Springer, Berlin 1927.

8 Final data in: Untersuchungen zur Genetik der geographischen Variation III. "Roux's Arch. Entw. mech." 1932.

of Lymantria[9]. There were found races in which young caterpillars were dark and remained so through all instars. There were others which had light markings and which remained light through all instars. And there were again others which were light in the young stages and turned dark in later instars. Between these extremes all transitions were found as the curves of pigmentation show, and each of these types is produced by a member of a series of multiple allelomorphs. A closer study of the facts then reveals that each allelomorph of the series is responsible for a process of accumulation of dark pigment on the basis of light markings, a process which proceeds with a definite velocity which is typical but different for different allelomorphs of the series, as may be demonstrated in a diagrammatic curve (9). Here then we found again a series of multiple allelomorphs connected with a series of reactions of different velocities, and we concluded that also this series, and, perhaps, most similar series, must consist in one and the same gene in different quantities. In this case, of course, the conclusion rests on analogy, and no way to prove it is apparent. This case, however, furnished another fact which pointed in the direction of the general theory. If we cross the always light race with the always dark race the young first generation caterpillars are first light, but later they become dark. In Mendelian language, light was first dominant and lat r dark.

If we remember the last curves, it is clear that the curve which is midway between the ones of the light and dark races, has exactly this type, first light, later dark; and as a matter of fact, the intermediate allelomorphs of the series also produce the same effect as observed here in the hybrid.

This then shows clearly that dominance, recessivity and change of dominance are here the phenotypic effects of the type of reaction curve within the whole system. From this fact then may be derived a few theoretical cases which simultaneously are apt to serve as a model for the whole generalization.

Let us consider what dominance might mean within a system of genes which are responsible for reactions with velocities in proportion to the quantity of the genes.

The diagram (10) assumes that we consider two allelomorphs, each producing a reaction of different velocity represented by straight lines. At a certain level or threshold marked by the line M, the determinative reaction takes place. Let us now assume that we are dealing with the size of an organ which is the result of a given number of successive cell-divisions. The reaction in question may stop the cell divisions and therefore the resulting size of the organ will be smaller and smaller, the more early the reaction curve reaches the level M. If the cell divisions proceed with equal time intervals and if the reaction velocity for the heterozygote is per definitionem intermediate between the two parents, the size of the organ will also be intermediate. Let us now assume that the cell divisions in question proceed first slower and then faster, as represented on the line M_1; the same system leads then to almost complete dominance of the greater size; if, however, cell divisions proceed first faster and then slower as represented on line $M_{,,}$, we find almost complete dominance of the smaller size.

I think that this diagram which follows immediately from the preceding analysis, is rather instructive. It demonstrates a simple interpretation of dominance; furthermore, we have to assume that the three forementioned types of cell division are themselves determined directly or indirectly by the action of other genes, which in genetic language are usually called modifiers. Dominance then is the result of the interaction in time of the heterozygous main gene with a number of others, the modifiers. Those among you who are acquainted with Fisher's so-called theory of the origin of dominance will realize at once that only such a system, as presented here, will allow that dominance is changed by selection of modifiers. Moreover, the diagram may be used as a model for all possible determinations of developmental processes into which the embryology of an individual might be dissolved. By changing the meaning of the variables, introducing new ones, or other threshold conditions, similar models might be derived for all kinds of facts relating differentiation to genic action. Finally, the diagram may show that it is of no use to discuss the problem of the quantity of the gene without considering the corresponding reaction velocities through which alone the assumption of different but typical gene-quantities becomes important; because without this connection we have only a sterile hypothesis.

Let me illustrate finally this point by an actual case. Dobzhansky[11] some time ago set out to disprove the quantitative nature of multiple allelomorphs in the following way: he argued that if we consider a series of multiple allelomorphs which produces manifold phenotypic effects in different organs, these effects must show always a parallel seriation in different combination of these allelomorphs, if the genes in question form a quantitative series. A study of the facts did not prove this to be the case, and therefore he concluded that the allelomorphs cannot be of a simple quantitative nature. As a matter of fact, the premises of this argument are already wrong, because the main point has been neglected: namely, the system of reaction velocities. This will be evi-

[9] Short accounts of the main facts were published in: A preliminary report on some experiments concerning evolution. "Am. Natur." 52, 1917; and "Die quantitativen Grundlagen, etc." (see note 7). A detailed report is found in: Untersuchungen zur Genetik der geographischen Variation. I. "Roux's Arch. Entw. mech." **101**, 1924; dto. II Ibid **116**, 1929. Consult this for photographs and curves.

[10] Taken from "Physiologische Theorie der Vererbung" 1927.

[11] Dobzhansky, Th.: The manifold effects of the genes stubble and stubbloid in Drosophila melanogaster. "Zs. ind. Abstl." 54, 1930.

Goldschmidt, R.: "Bemerkungen zur Kritik der quantitativen Natur multipler Allele." "Philiptschenko Gedachtsnisband," Leningrad 1932.

dent at once if we consult again a similar diagram as before. We have represented three allelomorphs by their reactions of different velocities which lead to a determinative effect at a certain threshold after the time I, II, III. Let us assume again a very simple type of effects, namely, the cessation of growth of an organ at the time in question. Each organ of which the size is influenced by the series of allelomorphs may, of course, have its own curve of differentiation which is determined independently of the allelomorphs in question. In order not to complicate the diagram, some of the such possible curves have been drawn below. The size of the organ reached at the decisive times I, II, III is then represented by the verticals Ph. I, II, III. In the first case, the organ shows a steady increase with the three allelomorphs in question; in the second organ the first two allelomorphs produce the same effect; in the third organ the effect is identical for the second and third allelomorph. The fourth case represents the growth of an organ in two dimensions represented by a length-breadth index. L is the curve for a constant growth in length, W, the curve for intermittent growth in breadth, and the proportion of the two verticals at time I, II, III, the respective index of the resulting phenotype. In the case which is represented, this index is first high then low and then again higher. This simple diagram shows then how in such a system of timed reactions a series of causes of a definite order, for example, a set of different quantities of a gene, might produce effects of a very different order in different organs.

A third example of the application of the general idea might be discussed which is to be regarded as representative for a certain group of problems. The wing of butterflies and moths constitutes after a certain critical period, which is situated towards the end of the larval stage, a self-differentiating system. A nice demonstration of this I was able to give many years ago[12] when I showed that it is possible to change the speed of differentiation of one wing without altering the other wing of the same individual at all, namely, by blocking the blood supply to a certain extent. We may have side by side the normal wing which almost has finished its differentiation and the operated wing of the same animal which shows structure and coloration of an earlier larval period. (These experiments, by the way, have anticipated the general type of some recent experiments performed on amphibian eggs with local temperature changes). This self-differentiating system of the wing pattern is finally determined during the critical period. At this time when the wing is a simple epithelial sac showing no visible differentiation on its surface which would correspond to a later pattern, the future pattern is already completely laid out. How this is done we do not yet know. But two significant facts have come to light which may be regarded as the beginning of an understanding. One related to the wing of intersexual males of the gipsy-moth. Such a wing exhibits the characteristic mosaic streaks of white female color upon the brown male wing. If these white patches are large, it can be shown that they have also a different rate of growth from the brown areas. At the time of pupation, of course, no such structure can be seen on the epithelial wing, but in some cases the wing-mosaic may be faintly but clearly seen on the pupacase, which has been secreted by the wing epithelium. This shows that the pattern is already present in the form of some difference in regard to the secreting activity or some other process involved in the formation of chitin by the wing-surface. A little later, however, but a long time before any pigment appears, the difference in question can be made visible, and it may be shown in what it really consists. That is, the prospective white parts of the wing are far in advance of the later dark parts in regard to the differentiation of the scales. This may be made visible by drying the wing that has been taken out of the pupa. The prospective white parts carry well chitinized scales which remain erect when drying; the future dark parts, however, are still carrying younger soft scales which collapse in drying, so that on a wing treated in such way the future white parts stand out in relief[13]. This then shows in one case that the primary pattern formation consists in producing areas with a different speed of differentiation. These findings in the intersexual wing proved further to be in full harmony with other results in regard to the development of the wing pattern, which had been found in other objects. I could show that the normal wing pattern in many different types of butterflies and moths is laid down in the same way[14], namely, as regions of different speed of differentiation.

The following slide showed a swallow-tail **Thais polyxena** with its characteristic pattern and besides a wing taken from a pupa, before any pigment becomes visible. In drying the wing, the ghost pattern becomes visible because the future light scales remain erect, but the future pigmented scales collapse. The photograph does not allow it to be distinguished clearly, that no pigment at all is involved in this picture. This is more easily visible in another picture representing an unpigmented pupa wing of a cecropia moth. The white margin of the eye spot is easily seen as a group of erect scales, whereas those of the dark spot are collapsed.

The second important fact has recently been

12 Untersuchungen zur Entwicklungsphysiologie des Flugelmusters der Schmetterlinge. "Arch. Entw. mech." 47, 1920.

13 For particulars and discussions see: Untersuchungen uber Intersexualitat. II. "Zs. ind. Abstl." 29, 1922; Einige Materialien zur Theorie der abgestimmten Reaktionsgeschwindigkeiten. "Arch. Entw. mech." 98, 1923. The majority of the extensive studies of the author and his former student F. Suffert have never been published. The same principle has been always found at work.

14 Papers quoted in note 12 and 13, see further: Physiologische Theorie der Vererbung.

found by a student of Professor Kühn[15]. In the larval wings of the meal-moth at about the critical period he found zones of intense mitotic divisions, which corresponded to later elements of the wing pattern, elements which later follow the same law which we just described. Though it is not yet possible to coordinate and to understand all these facts, they might be represented in general terms at present in the following way: in the critical period which corresponds to the time of irreversible determination found in each study of developmental physiology of any organ, a pattern appears of physiologically different areas on the wing, different in regard to their growing activities and to their relative speeds of differentiation. This suggests the appearance and typical distribution of something like a growth hormone. All the rest of the differentiation of the pattern, however, is nothing but the consequence of a coordinated system of reaction velocities in regard to differentiation and also to chemism.

The following diagram (3) may serve as a model for the whole process which might be varied indefinitely to fit individual cases. We assume that the wing area differentiates during the critical period into three different parts, according to what we have seen before. Each of these areas I, II, III begins to differentiate at a different rate represented by the three curves T_1, T_2, T_3. At the level of the points $T'_{1\ 2\ 3}$ the respective scales have reached the stage or threshold which permits of the deposition of pigments. We then see three independent gene-controlled chains of reaction which are supposed to result in the formation of some component, requisite for the final deposition of yellow, red, and black pigment respectively within the scales at the times Tp_1, Tp_2, Tp_3. Now at the time Tp_1 only the area I is ready to receive the stuff P_1, and therefore only this area will contain yellow scales; similarly for the two other areas. It is clear that this diagram which is based on the actual facts, may be varied to fit any type of pattern, pigment, etc., and that it might be as well used as a model for many processes of determination which after all are nothing but formations of patterns.

Only one of the consequences may be mentioned, partly because it is connected with some of our own work, partly because it opens up vistas in another direction. The classic temperature experiments with butterflies have shown that it is possible to change the inherited wing pattern by applying extreme temperatures and other extreme conditions to the animal within the critical period, the duration of which has been exactly determined[16]. One of the well known results of this old work, which we have repeated on a large scale, is the fact, that in a number of cases it was possible to produce in the temperature experiments forms as non-heritable modifications, which are phenotypically identical with well known geographic sub-species, a fact which plays a considerable rôle in Lamarckian discussions. A typical case is the case of *Vanessa urticae* from the European continent and the subspecies *ichnusa* from Mediterranean islands; the phenotype of the latter is exactly reproduced in the temperature experiments with the former. Many similar cases are known.

The following diagram (4) gives the type of explanation of such cases, I repeat, the type, because no actual analysis has been made, which would show which individual reactions are concerned with the special case. The diagram therefore does not claim to cover the actual case but to represent the type of explanation which has to be applied, all details being indefinitely variable to fit the individual case. We assume that the phenotypic differences of the two forms in question are differences in the area which one definite element of the pattern occupies. This relative area is determined during the critical period which is supposed to end at the time Se-Se. One of the simplest possibilities for the determination of the size of this area is, that it is proportional to the time which is available from the beginning of its formation to its final determination with the end of the critical period. Both of these points are, of course, determined independently and genetically, and we express this by assuming a genetic chain of reactions AA which reaches its active minimum at the level W, and a second chain S which determines similarly the time at which the critical period ends Se-Se. The distance between the two times, 9, then is proportional, to the area of the pattern element in question. Now we might have another race in which genetically the curve AA is replaced by A_1A_1, and therefore the area of the pattern in question is proportional to the distance q_1, that is, bigger. If I perform now a temperature experiment during the critical period, and the S and A chains have a different temperature-coefficient, I might shift Se to Se_1, without touching A. Now our area is proportional to the distance qt which is equal to q_1, and the phenotype is exactly identical with the one of the race A_1. Speaking generally, we learn from this diagram that it may be possible within a system of timed reactions to produce a certain new phenotype by shifting one of the reactions, by changing its velocity. This shifting, however, and therefore the same effect, may be due either to an external agency like temperature, or to a mutation of the gene which lies at the basis of the reaction in question.

There is one consequence of these considerations, which seems rather important. In such a system of timed reactions, there are not many degrees of freedom imaginable for the individual reaction, which would not upset the whole system. Therefore viable mutations are limited, and furthermore within such a system viable mutations are only imaginable, the phenotype of which

[15] Kohler, W.: Die Entwicklung der Flugel bei der Mehlmotte Ephestia Kuhniella Zeller mit besonderer Berucksichtigung des Zeichnungsmusters. "Z. Morph. Oekol." Tiere 24, 1932.

[16] The well known work of Standfuss, Weismann, Fischer, Merrifield. Determination of the critical period by my former student F. Suffert: Bestimmungsfaktoren des Zeichnungsmusters beim Saisondimorphismus von Araschnia levana prors. "Biol. Centrbl." 44, 1924.

might theoretically also be obtained by proper external action as modifications. This means that if we know the proper agents and the proper critical periods, we ought to be able to produce also the phenotype of every imaginable or known mutation in the form of a non-heritable modification. Putting aside the manifold obvious cases of this type in quantitative characters like size, I might mention that I succeeded in producing the exact phenotype of a considerable number of Drosophila mutations as non-inheritable modifications through the action of extreme temperatures at different critical periods. It is very significant that in such experiments usually the modification in question appears simultaneously in a series of degrees, paralleling exactly series of known or also not yet known multiple allelomorphs[17]. If we remember what we heard before about such series and the reaction velocities, the wonderful consistency of all the facts and their connection through a rather simple idea becomes once more apparent.

I do not think that much imagination is needed to apply the different models of the argument, which have now been discussed, to any imaginable process of differentiation which proceeds orderly with time, and I believe that the relation between the gene and that part of the process of embryonic differentiation which belongs to the dimension of time is adequately explained by the system of timed reactions and what belongs to it. This, however, is only a part of the problem of embryonic determination. There is in addition the differentiation of the substratum in the three dimensions of space without which the reaction system which produces the right thing at the right time, could not be imagined to produce it also in the right place. There can be no doubt that the spatial differentiation of the substratum is also produced at definite times by the same system of genic and timed reactions. Under normal conditions, a certain embryonic area, say a limb-bud, is equipotential up to one moment and differentiated into parts of different potency from that moment on. And this time of determination may be different but genetically fixed in nearly related species. We discussed this point already in regard to the wing pattern. Further, all the elementary facts of experimental embryology, beginning with the analysis of the different types of eggs in regard to determination prove that the progress of differentiation may be dissolved into a series of exactly timed events, consisting mainly in some diversification of the substratum, be this the egg which is to be regarded as an individual system, be it progressively smaller and smaller areas of the embryo, now to be regarded as the individual systems, which change at a certain moment from a monophasic to a polyphasic condition[18]. The causation of this change still belongs to the domain of physiological genetics, and is adequately understood by the system of timed reaction velocities. But in what this change consists and what are its consequences in regard to determination, this is the proper domain of experimental embryology. The experimental facts have been described under many headings since the days, when He first understood the problem with a really prophetic vision. Organ forming stuffs, chemodifferentiation, embryonic segregation, and the organizator are all terms for the observed facts of the same order. The organizator conception in addition has led an important step further, because it connects the facts of the diversification of the substratum with former causative events and therefore opens the way for a dynamic understanding of a sequence of events, which has been started at one point. And the theory of the metabolic gradients, which constitutes the physiological corrollary to the morphological organizator-concept, makes visible one of the ways for a causal explanation of the whole process.

Whatever this process of the diversification of the substratum, or in one word, including all visible types, the process of stratification, might be, its meaning within the genetic system of timed reactions is clear. It allows the products of the genic reactions to act or not to act or to act differently on different areas of the germ; it creates secondary and tertiary systems, influencing the course of the genic reactions differently in the different regions, allowing one and the same original chain of reactions to lead to different consequences in the different areas, and the same over and over again up to the end of differentiation.

It would be pleasant to point to a few of the consequences which might be derived from such views as the ones presented here, consequences in regard to special and general problems of genetics, problems of mutation, evolution, the understanding of rudimentary organs or embryonic recapitulation. But these conclusions may be easily drawn by anybody who is willing to accept the soundness of the basic idea[19].

17 Only a short notice has been published, though a considerable material has been accumulated. Jollos, who has repeated the experiments with the same results, is preparing a communication which relieves me from publishing the details of my results.

18 Detailed discussion in "Physiologische Theorie der Vererbung."

19 Some of them have been presented in "Die quantitativen Grundlagen, etc.," "Materialien zur Theorie etc." and "Physiologische Theorie, etc." quoted before, others have meanwhile been drawn by other authors, who accepted the general trend of our ideas.

Ladies and Gentlemen! A few years ago, one of the leading biologists of this country professed right here his opinion that the time has not yet come for genetics to join hands with experimental embryology. Permit me to conclude this lecture by expressing most emphatically my conviction that not only this time has long since come, but also that the foundations for an understanding of development from the standpoint of physiological genetics have already been laid. Indeed a considerable part of the frame-work stands ready around which to erect a good building.

CYTOPLASMIC STRUCTURES CONCERNED IN THE DEVELOPMENT OF THE EARLY EMBRYO

(Continued from Page 253)

cotton wool, the material passing through will reform as a plasmodium; that is, there are no specific structures in the protoplasm aside from the nucleus. Such an organism therefore does not contain within itself the cytoplasmic structures which make possible a multi-cellular animal, i. e., differentiation into something dissimilar to the mother cell. Such cytoplasmic structures appear as a rule in the case of the metazoa after the fertilization of the egg. It is on these structures, which seem to be comparatively simple chemical compounds, that the development of the blastula and subsequent larva depend. If we take away certain of these structures, or weaken them, the larvae cannot develop normally.

In the Coelenterates the eggs have no membranes. The blastomeres are held together by cytoplasmic processes. Metchnikoff (1884) showed that this was the case in Medusa; later Hargitt found the same to be true of the Pennaria at Woods Hole.

Most of our experiments have been with the Pacific Coast sea urchins. The fertilized egg of Strongylocentrotus has a fertilization membrane and a hyaline membrane closely investing the blastomeres. If the eggs are put into calcium-free sea water the hyaline membrane disappears. If the fertilization membrane is broken and the hyaline membrane then made to disappear, the cells divide but do not form a blastula. The membranes are therefore mechanical essentials in the transformation of dividing eggs into blastulae.

It can be shown that the hyaline membrane behaves like a calcium proteinate, in the following way. If eggs are treated with sea water at a pH 4.0, the hyaline layer rounds up into droplets, absorbing water from the perivitelline space. If the eggs are now centrifuged, the physical connections of the droplets with the egg are severed. Upon return to normal sea water a new hyaline membrane is exuded from the egg. The larvae resulting from such an egg will be perfect but will be smaller by the amount lost in the reformation of the membrane. The hyaline layer cannot therefore exist in an acid solution. It can on the other hand, be strengthened in sea water at pH 8.0, by adding calcium chloride to the sea water. If this be done the hyaline layer becomes tough and comparatively indestructible, retaining the blastula within its shell for as long as a week.

The formation of both fertilization and hyaline membranes is easily prevented by treating the unfertilized eggs with a solution of non-electrolyte. Five to ten seconds is a sufficient length of time in the non-electrolyte solution. They are then returned to sea water and fertilized. They divide normally and form loose clusters of cells held together by strands which we term primary cell bridges. Eggs of the sand dollar, Dendraster, which have been treated in this way, if shaken when they are in the four cell stage, are extended into chains. If such a chain be watched till the micromeres form, it will be seen that the end cells go to form the animal pole, and the two inside cells, the vegetal pole of the blastula. Subsequently cell plates and half blastulae form, which later disintegrate. For a simple physical reason, therefore, the lack of confining membranes makes it impossible for the larva to form, because for this a closed cavity (the blastocele) is necessary. The situation is different in the European sea urchins. In Paracentrotus and Echinus, with the formation of micromeres the blastomeres are drawn together and later form a blastula. If, however, these larvae are put into calcium-free sea water, the blastomeres fall somewhat apart and numerous strands can be seen connecting them. These strands later break and the cells fall entirely apart. Such strands we speak of as secondary cell bridges. Droplets run along them very much as in strands connecting mesenchyme cells.

If the eggs of *Paramecentrotus lividus* are exposed for a few minutes to an isosmotic solution of glycerol to which has been added sodium chloride in total concentration .05 M, only the hyaline membrane will form after fertilization, and the resulting blastomeres will fall apart a little. If the concentration of sodium chloride is increased to .10 M, the fertilization membrane is formed but not elevated, and the result is an almost solid blastula. After a still greater increase of the salt to .14 M, the fertilization membrane is formed and elevated and the result is a normal blastula. It was found in the case of these eggs that the complete membrane-forming function can be saved in an isosmotic solution of glycerol containing either magnesium, strontium, calcium or barium ion in .002 M concentration; likewise if the solution contains lithium, sodium or caesium ion in .14 M concentration, the membranes are saved.

The question as to how the non-electrolyte works became important to consider. A series of experiments was carried out with the eggs of *Strongylocentrotus purpuratus,* using isosmotic glycerol as the non-electrolyte solution. The efficiency of the solution in suppressing membrane formation was tested for different pH's. The experiment was made by putting a drop of eggs in 25 cc. of solution and agitating. Every five seconds some of the eggs were removed to a watch glass containing sea water, and fertilized. Thus the minimum time was determined for the suppression of the membrane formation. The rate is the inverse of the time. The shortest time and highest rate for the effect was found to be at pH 9.0 with a slight falling off down to pH 5.5, after which the curve dropped abruptly to a theoretical zero at pH 4. The graph of this reaction is a broken curve. Just what this means we do not know, but it may indicate an iso-electric point. A second experiment showed how the action of hydroxyl ions in destroying the pre-membrane stuff is inhibited by Ca ion.

These effects are somewhat similar to those obtained by Gray on the solution of the intercellular matrix of Mytilus epithelium. That worker has found that if such epithelium is put into a solution of urea or even NaCl, the cells fall apart when the matrix dissolves. There is a striking similarity between the curves of Gray's results and of mine for the solution of the pre-membrane stuff.

A third cytoplasmic system which behaves like a protein is that of the egg core. If the unfertilized eggs of the sea urchin are put in a non-electrolyte solution at pH 4.0, they begin to disintegrate. If the cells are observed under high power the granular mass inside the cell becomes suddenly active showing Brownian movement, finally ending in the granules pouring out as though grain from a sack. The reaction depends upon the electrolyte and the pH of the solution. If the pH of the solution is 7.0 or 8.0, the cells remain unharmed for an hour at a time; while if the solution is acidic, they fall apart in one or two minutes. The center of the cell is thus labile only at an acid pH in the absence of metallic ions; it is stable with an excess of hydroxyl ions alone and with metallic ions. The core thus differs from the hyaline membrane which is labile in an acid medium (pH 4.0), even if the medium contains metallic ions. The core and hyaline membrane thus differ strikingly from the fertilization pre-membrane since the latter is stable in the presence of hydrogen ions and labile in the presence of hydroxyl ions, provided metallic ions are not present.

As to the part played by the structures we have considered in building the blastula, it is clear from the experiments that the blastomeres must be held together either by outside membranes or by processes connecting them or by both, in order to form larvae. The effect of the outside membrane in holding the blastomeres together can be further tested without destroying it. For example, if starfish eggs after fertilization are exposed to a solution of a non-electrolyte, the fertilization membrane will be pushed out. The normal diameter of the membrane is .21 mm.; after it has been thus treated, it reaches .27 mm. The result of this extension is that the blastomeres in the expanded room tend to fall apart and bizarre gastrulae result. It was found possible to make an artificial substitute for the membrane, showing that its effect is mechanical in nature. We first tried setting membrane-free eggs to develop in holes in a paraffin plate. This did not work because it was impossible to make the holes sufficiently exact. Finally the membraneless eggs of Dendraster were found to develop well in a solution of agar in sea water. If the agar was stiff enough the blastomeres were held together so that they formed closed blastulae. A half per cent. solution was not firm enough but three-fourths and one per cent. gave excellent results, i. e. closed blastulae and later gastrulae.

An experiment of a different type deserves brief mention in this discussion of cytoplasmic structures and embryonic development. It concerns the relative parts played by nucleus and cytoplasm in determining the segmentation rate of dividing eggs. In Pacific Grove there are two Echinoderms which readily hybridize but which have widely different segmentation times. *Dendraster eccentricus,* the sand dollar, accomplishes its first division at 20° in about 57 minutes and each subsequent division in 28 minutes. The eggs of Strongylocentrotus, the sea urchin (2 species), divides in 95 minutes after fertilization and subsequently every 47 minutes, approximately. In cross fertilized eggs the segmentation time is always the time characteristic of the egg. One cannot, however, conclude from such an experiment that the cytoplasm of the egg alone is concerned since the egg nucleus is present and may effect events remote from itself. It therefore became necessary, in order to solve the problem, to remove the egg nucleus, afterward fertilizing the enucleated cytoplasm with the foreign sperm. By means of a micro-dissection needle the nucleus has been removed from the eggs of Dendraster, sometimes with a small amount of cytoplasm, sometimes the egg was simply cut in two. The pieces were then fertilized with the sperm of *Strongylocentrotus franciscanus*. The result in all cases was that the enucleated piece of Dendraster egg divided in the time characteristic for Dendraster, and there was no difference in tempo between the piece containing the egg nucleus and the piece containing none. The experiment proves then that the segmentation time in these echinoderms is a function of the maturated cytoplasm alone. In the case described, the cytoplasm forced the slow sperm nucleus to perform its division in a little more than half its normal time.

(This article is based an a lecture presented at the Marine Biological Laboratory on August 18.)

SURVEYING IN NORTHERN LABRADOR

Dr. Alexander Forbes

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Dr. Jacobs has asked me to tell you something about our cruise in Northern Labrador. This cruise originated in a suggestion made several years ago by Sir Wilfred Grenfell. He said, "If you like cruising, why don't you come up and map one of the uncharted fiords in Labrador." The prospect was intriguing. Most of the coast of Labrador is very crudely charted and was unsurveyed in the northern part, which included high mountain ranges, containing the highest peaks on the Atlantic coast. So the plan developed.

It seemed worth while also to look into the natural history—there were some very interesting geological problems. There are remains of glaciers from an old ice age—also problems concerning the configuration of mountains in relation to glacial history were to be solved. To what extent the ice sheet had covered the mountains remained to be determined. Certain flora can be found in parts of Newfoundland, which have survived the Wisconsin ice sheet. This last ice sheet, which covered the northern country about 25,000 to 50,000 years ago, left a certain area untouched, as shown by plants which date back beyond that age—so-called "conservative plants." Geological evidence supports the same conclusion. Dr. Fernald believed that the same picture might be found in the mountains of northern Labrador. Therefore it seemed worth while to have a geological and botanical objective to the expedition as well as a geographical one.

It was suggested that we use an airplane for this work, and after comparing the relative efficiency of airplanes and human legs in doing survey work in a rugged country, we decided that certainly it would be a waste of time and energy to attempt such a project without an airplane. It would be impossible to take a land plane because there is no place to make a landing in a country with such jagged peaks and rough terrain; so a seaplane was required. An aerial surveying camera was hired.

We then needed someone competent to take charge of the surveying and mapping. It was a fortunate coincidence that Mr. Miller, instructor in the American Geographical Society's School of Surveying, had just developed a new method of making maps by means of aerial photographs. The Byrd expedition had just returned, and with the aid of Miller's method their photographs furnished a good map of the Queen Maude mountains. Mr. Miller had had no opportunity to organize a survey to demonstrate his new method, and was therefore eager to experiment with it.

There are several methods of mapping from aerial photography. One is to have the plane fly over the country and take over-lapping vertical photographs; this is very good for shore line work and may be used for topographical relief mapping. If stereoscopic methods are used, the heights of mountains can be determined — there are very elaborate machines for this in Italy. The method of using vertical pictures was much too detailed and expensive for the large area to be covered and with the time at our disposal—like doing gross anatomy with a high power microscope. Another method, used in Canada, is the grid method. The plane takes oblique pictures including the horizon, and a perspective grid is drawn on the photograph; the features are then redrawn on a corresponding rectangular grid. Miller's method is essentially one of triangulation: two different photographs are taken which contain certain points of known position, and by a system of triangulation it is possible to determine the exact position of the plane in the air when the picture was taken, and then to determine the location of any other unknown point which appears in both photographs, provided they contain also the two known points and the horizon. He was very keen to put his method into practice, and the American Geographical Society directed him to go with us and take charge of the survey.

The Labrador coast can be divided into three sections. To Indian Harbor it is fairly accurately charted. From there north it is unsurveyed, and very sparsely settled, though there are Eskimo villages. From Cape Mugford north there is hardly any human life. There are three ranges of mountains, the most dramatic being the Torngat Mountains, which according to Eskimo legend are inhabited by evil spirits. At Hebron is the last Moravian mission, and beyond that there is no human life. It is a mountainous region cut by magnificent fiords.

The first item to be considered was a good boat. We got the schooner that Captain Iselin had built for oceanographic research and which was called the *Atlantis.* This name was wanted very much for the new boat down here; so the new name *Ramah,* was given to our boat, and she was fitted out with an auxiliary engine, which burned oil for fuel. We obtained an old Fairchild plane which had been used by the Telephone Company for scientific work, and another smaller one, a Waco biplane.

In the middle of June, 1931, we left Boston for Sydney, Nova Scotia. Thence we proceeded to St. Anthony, the headquarters of the Grenfell Mission. We set sail from St. Anthony on July 2, and on July 4 reached Gready, a typical Labrador settlement. We anchored there in a "tickle," which is a narrow passage between two islands. We discovered that the tide always runs south in this "tickle"—probably because of the Labrador current. There was a fair-sized iceberg not very far away and some of the boys went out to get ice for the refrigerator.

The next stop was Indian Harbor, which is the site of the northernmost of the Grenfell Hospitals. A large fishing fleet was anchored there. Here our surgeon was much in demand, since the doctor at the Grenfell Hospital has to divide his time with a settlement some distance away and there were a number of ailments which had accumulated during his absence.

The charts we had supposed to be accurate as far as Indian Harbor; and, as a matter of fact, their accuracy stopped right in the middle of the harbor. Relying on a harbor chart to show the depth of water, we started out only to run aground almost immediately.

Mr. Miller and I went up in the plane to look out for pack ice, since the route we should take might depend upon its presence or absence.

We went into Hopedale for fuel and here the charts were very confusing. We were told we should have a local pilot on account of the shoals, but we had a device which enabled us to get through without a local pilot on our already crowded boat—a sort of submarine kite, devised by Magoun. Two of these with a wire drag between, were towed ahead of us by the tender, at a greater depth than our keel.

At Hopeland we took on all the gasoline we could stagger under, because no more could be obtained beyond there. We planned to put out to sea here, but were fortunate in running across Captain MacMillan who offered to guide us through the inside passage up to Nain. He took us through a labyrinth of barren, rocky islands covered with spruce or fir.

We put out to sea at Port Manvers and sailed to Cape Mugford—a region of volcanic rock, including peaks over 3,500 feet high. We anchored here in order to give Odell and Abbe an opportunity to explore the mountains, some of which had never been climbed before, for items of geological and botanical interest.

At Hebron the Hudson Bay Company and the Moravian Mission occupy the same quarters; one takes care of the food, the other of the social and religious problems.

Our main base was laid at Kangalaksiorvik. We reached it in a dense fog, aided by photographs which Miller had taken on a preliminary reconnaisance flight. From there Miller did the major triangulation. Kangalaksiorvik means "place where you can hunt deer while they are changing their hair." This country is covered with fireweed and dwarf willows. One species of dwarf willow has leaves about one inch in diameter and grows about six inches above the ground. We used twigs of this for firewood. Another species has leaves one-fourth inch in diameter and grows one-half inch above the ground. It would not appear to be a tree to the uninitiated but Abbe assured us that it was so technically.

It was found that the highest peaks were about 5,000 feet high rather than 7,000 as had been stated heretofore.

A very ingenious dark room was set up by the mate, who was an architect. We had supersensitive films; so the room had to be absolutely dark. Water was brought in by hose from a brook and a trough was constructed for washing the large rolls of film. A drying frame was set up and protected with an awning and mosquito netting. The water from the brook had to be heated on an improvised stove to make a developer warm enough to work.

In the Komaktorvik valley salmon were abundant, but they would not touch a hook, and had to be shot with a gun.

At Ryan's Bay we were surprised to find two tents on the shore. Two Eskimos came out in their sealskin kayaks. They were obviously very healthy, much more so than those we had seen farther south. The reason probably is that those in the south live a life to which they are not adapted, subsisting on the flour and canned supplies distributed to them by the Hudson Bay Company, while the nomadic Eskimos eat little but raw cod, seal and caribou, which are teeming with all the vitamins of the alphabet. Their teeth are better, their physique is much better, and there is a great deal less tuberculosis. They were very intelligent in studying the photographs of the region which we had, and identified some of the places for us—we took down the names phonetically and later learned their meanings from a missionary. They were not so intelligent, however, in providing for themselves. Someone was very much attracted by their bone-tipped paddles, and on being offered Ingersoll watches in exchange, they gladly handed them over. They had to be towed ashore in consequence, and it turned out that there was nothing there with which to make more paddles, and it is difficult to see how they would have been able to get food. One of the men took pity on their plight and returned one paddle.

From Ryan's Bay we sailed north to Ekortiarsuk, in Latitude 60°, our farthest north. Here Miller made a separate triangulation, but tied it to the main triangulation with points intersected from both. Thus he established an extensive ground control which will serve as a skeleton for the map.

In fifteen hours of flying time, about 550 pictures were taken which covered an area of 4,000 square miles. Several months' work will be required to complete the final map.

CHANGES IN SUSCEPTIBILITY OF DROSOPHILA EGGS DURING EARLY DEVELOPMENT TO HARD AND SOFT X-RAYS, GAMMA RAYS OF RADIUM AND ALPHA PARTICLES

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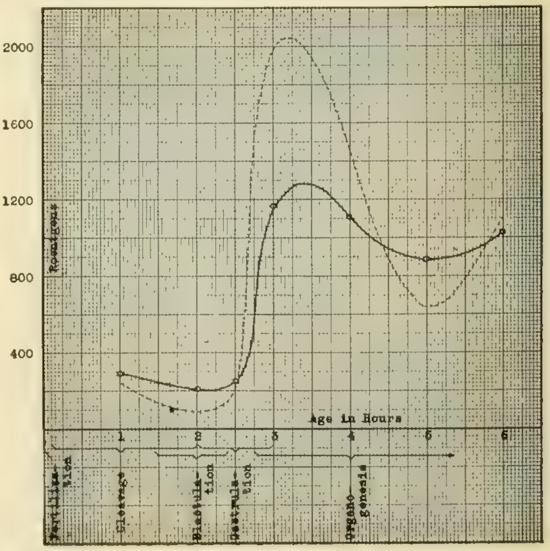
The experiments to be discussed here deal with the effects of different kinds of radiation on Drosophila eggs in the early stages of development. They are mainly exploratory in nature and were performed originally as a foundation for other work in which Drosophila eggs were used as test material. The results when obtained, however, indicated that the methods of investigation used might also be useful in studying certain factors influencing development. Attention will first be called to some of the changes which take place in the egg during early development, after which a brief description will be given of certain responses to the radiations.

The Drosophila egg is centrolecithal in type. The egg and sperm nuclei unite near the center of the egg and the early cleavages, nuclear only, take place synchronously in the central region at the rate of 1 in 10-12 minutes at room temperature, 22-25° C. At about the eighth or ninth cleavage, the nuclei begin to migrate to the periphery where cell membranes are formed around them and where they arrange themselves in a single cellular layer to form the blastoderm. This thickens by continued mitosis and very soon, gastrulation begins by invagination.

Attention may be called more specifically to certain functional activity which is going on at the different stages in the eggs. Since cleavage is synchronous among the cells (or nuclei) it is clear that the total number of cells is doubled with every cleavage. Accordingly, at the ninth cleavage when the nuclei are moving toward the periphery, 512 cells are present. The next cleavage takes the number to 1024, the next to over 2000 and the next to more than 4000, etc. From this it is evident that one of the first steps at the beginning of differentiation is a slowing of the rate of multiplication of cells. By careful examination of the process at the beginning of gastrulation (which is also the beginning of somatic differentiation), it is apparent that mitotic activity is momentarily limited to those few cells involved in the formation of the initial bud. Where a total of more than 1000 cells was active just before gastrulation, the number is reduced to a very few at the time of gastrulation—a tremendous reduction in percentage of cells active. The remarkable uniformity of activity among the cells gives way to diversity and specialization. It becomes clear, therefore, that the beginning of gastrulation is a time when extensive changes in the regulative control of development takes place. Other investigations have indicated that organisms are the most susceptible to radiation when mitotic activity is the highest, and that the time



of gastrulation is a particularly resisant stage in many organisms to depressing agents in general. It is of interest therefore to compare the radiosensitivity of Drosophila eggs at the various stages in development.

40 K. V. X-rays, 200 K. V. X-rays, gamma rays of radium and alpha particles are the different kinds of radiation which were used. The first three forms, for purposes here, may be considered electromagnetic in nature, differing only in wave-length. Alpha particles, however, according to the Rutherford-Bohr theory of the structure of the atom, are corpuscular in nature, being identical with the helium atom stripped of its two planetary electrons. In comparing penetration characteristics only, gamma rays are capable of penetrating fifteen cm. of lead, 200 K. V. x-rays are stopped by a few millimeters of lead, 40 K. V. x-rays are stopped by a few millimeters of aluminum and alpha particles are completely stopped by a single thickness of ordinary writing paper. The first three forms are therefore capable of penetrating uniformly to all parts of the Drosophila egg, but as shown by certain tests (which will not be described here) alpha particles do not. Since the results obtained for the different radiations are essentially alike except for alpha particles and since this difference can be accounted for entirely on the basis of penetration, experiments with alpha particles will not be considered further at this time.

For the other radiations, the results obtained are concisely summarized in the accompanying figure. The average age of egg samples from time of fertilization is shown on the abscissa. The solid line curve indicates the quantity of radiation, shown in roentgens on the ordinate, required to cause mortality in 50 per cent. of the eggs before hatching. Sections of a large number of eggs at different ages were prepared and with these it was possible to correlate the stages in development with the changes in radiosensitivity. This is shown at the base of the figure. It is seen that during cleavage, the time when the total number of cells is increasing rapidly, there is a slight increase in sensitivity to the radiation, but that at or near the time of gastrulation there is a sudden and extensive rise in resistance. As pointed out above, this is a period during which the total number of cells active in mitosis is very low. As the initial apical bud gets under way and others are formed, the total number of cells active is built up rapidly again and there is a corresponding increase in sensitivity. Thus it is seen that here again the radiosensitivity seems to follow in general the mitotic rate and that gastrulation in the Drosophila egg is a particularly resistant stage to radiation which is capable of penetrating uniformly to all parts of the egg (i. e. so far as mortality before hatching is concerned).

In closing, it may be pointed out that penetrating radiation is a particularly good type of agent to use in studying developing organisms. It penetrates uniformly and instantaneously to all parts and acts only during irradiation. Moreover relative dosages can be determined with a high degree of precision.

(This article is based on a seminar report presented at the Marine Biological Laboratory on August 9.)

GENE MUTATIONS IN PARAMECIUM AURELIA

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This investigation was undertaken to test the hypothesis advanced in my recent paper[1] that gene mutations occur not infrequently in *Paramecium aurelia*. Evidence of mutations both in the macronucleus and the micronucleus was found.

In this investigation care was taken to eliminate all environmental differences. The technique employed was that described in an earlier paper[2]. This included the use of a sterile salt solution as a culture medium with pure cultures of an alga and a bacterium as food organisms, the cultivation of the organisms on sterile slides in sterile Petri dishes, the daily transfer of the organisms to fresh medium with sterile micropipettes, and a constant temperature. In this investigation a further modification was introduced which consisted in standardizing the quantity of bacteria added each day. In this way not only were all the lines subjected to the same environment, but each line was cultivated on successive days in the same medium. The success of this modification was evident from the regularity in fission rates manifested by the different lines.

Since conjugation within a clone of Paramecium is genetically equivalent to self fertilization, recessive mutations which occur in the micronuclei can be accumulated during long periods of vegetative reproduction. Since the micronuclei do not function except at conjugation and endomixis when they give rise to the new macronucleus which is formed at that time, mutations which occur in the micronuclei would not manifest them-

1 Raffel, D. 1932. Inherited variation arising during vegetative reproduction in Paramecium aurelia. "Biol. Bull.," 62:244-257.

2 Raffel, D. 1930. The effect of conjugation within a clone of Paramecium aurelia. "Biol. Bull." 58: 293-312.

selves until after either conjugation or endomixis. If the mutations are recessive they would only produce their effects after conjugation when individuals homozygous for such recessive mutations would be produced. In this investigation a clone was tested and found to contain one recessive lethal gene as at conjugation it produced 25 percent. non viable progeny. Then branches of this clone were cultivated for about 70 days and each of five such branches was inbred. The results of these inbreedings showed that the branches contained 4, 5, 6, 8 and 9 such recessive lethal genes. Hence, in these 5 branches of a single clone between 3 and 8 mutations had occurred. That the mortality was produced by genetic factors is evident from the fact that the same clone produced only 25 percent. non-viable individuals in the beginning and also from the results of conjugation in another clone (22a) at the same time that the conjugants were obtained from the five branches of the clone tested for accumulated mutations. In clone 22a only about 20 percent. of the progeny were non-viable. Also conjugation was induced in one of the branches twice within about two weeks and in the experiments the amount of mortality was nearly the same.

Mutations occurring in the micronucleus if dominant or if recessive in pairs of genes already heterozygous would be expected to manifest themselves after endomixis when the macronucleus is replaced from one of the micronuclei. In this investigation persistent changes occurred after endomixis which were obviously due to such changes. The amount of mortality which occurred after endomixis differed in different lines. This was apparently due to the numbers of recessive lethal genes which they already contained and for which mutations would produce homozygosis. The line (clone 22a) which suffered the least mortality after endomixis was shown by conjugation to contain only one recessive lethal gene; while other lines which suffered more mortality were shown to contain between 4 and 9 such recessive lethals.

Most of the lines were uniform and constant in their rates of reproduction; but three of the lines became permanently altered after endomixis. Conjugation experiments indicated that one of the lines which remained uniform was heterozygous for only one pair of genes affecting fission rates as about 69.3 percent. of its viable progeny were alike and similar to the original. The mortality due to lethal genes made it impossible to determine the degree of heterozygosis for genes affecting fission rates in these lines.

Dominant mutations or recessive mutations in pairs already heterozygous occurring in the macronucleus should manifest themselves immediately. Their effects should persist until endomixis after which the normal characteristics should reappear. Among 144 lines which were cultivated at 32°C. for a week, five became altered in their fission rates. These were cultivated until the next period of endomixis. At this time one of them reverted to its normal fission rate as would be expected if the original change was due to a mutation in the macronucleus. The four other altered lines died at this time indicating that lethal mutations had occurred in their micronuclei in addition to the apparent mutations in their macronuclei.

Experiments were also carried out which indicated that in Paramecium as in other organisms a higher temperature increases the mutation rate.

That the changes observed in this investigation are due to gene mutations is supported by the fact that (1) they are not environmental effects because the experiments were carried out under constant and controlled conditions; (2) they are not cytoplasmic changes because they are reproduced at ordinary fission in all the progeny; (3) many of them appear only after conjugation by which homozygosis for recessive mutations is produced, i. e., they are transmitted by individuals which do not themselves manifest the affects of the mutations. The last point is best illustrated by the case already published (Raffel 1932) and the lethal mutations which produce non-viable individuals after conjugation in a normal line.

The occurrence of gene mutations in Paramecium explains many of the phenomena which have hitherto been inexplicable such as the increased variation found after endomixis by Erdmann (1920) the "dauermodifikationem" of Jollos (1921), the effectiveness of selection Parker (1927), the continued heterozygosis found by Jennings (1913), the mortality after endomixis (Woodruff and Erdmann 1914), the mortality in vegetative reproduction which occurs in all isolation culture work, and the question of senescence which was a center of controversy for many years.

(This article is based on a seminar report presented at the Marine Biological Laboratory on August 16.)

A NEW UNSTABLE TRANSLOCATION IN DROSOPHILA

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Approximately one hundred cases of rearrangements of parts of chromosomes have been studied genetically in Drosophila—most of them induced by X-ray treatment. As a rule the new arrangement has been found to be quite as stable as the typical one from which it arose; but there is a small class of unstable types, in which the new attachments break repeatedly.

The paper was a preliminary report on an incompletely analyzed member of this unstable group. This is a translocation of a piece from the extreme left end of the X chromosome onto the small fourth chromosome. The most imporant new point is that the resulting composite chromosome is unstable in two ways. The attached portion of the X is frequently lost, both somatically and germinally. In the germinal cases, at least, the fourth chromosome is not lost when this happens; but in other germ-cells a part at least of the fourth chromosome may be lost while the attached piece of X is still present. In this latter case the piece of X is still lost somatically with about the same frequency as when it is attached to an entire fourth chromosome.

A hypothetical diagram of the nature of the attachment was presented; but this must be considered as useful only for the purpose of helping to visualize the results, since the case is still not fully understood, and several complications remain to be investigated.

(This paper is based on a seminar report presented at the Marine Biological Laboratory on August 16.)

THE EFFECTS OF TEMPERATURE AND CERTAIN ORGANIC ACID RADICALS ON EUGLENA GRACILIS

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The present paper is an attempt to study the effect of lethal and non-lethal temperatures upon *Euglena gracilis*. The literature contains practically no definite information concerning this question. *Euglena gracilis* may be cultivated free from bacteria on agar or in broth in the same manner in which bacteria are cultivated. The method of cultivation and a counting method for determining the amount of growth in various cultures has been described previously (Jahn, 1929-1932).

The first group of experiments is based on the conception of thermal death times. As defined in bacteriological literature, the thermal death time is the time necessary to produce complete sterilization of a culture when the lethal temperature, the age of the culture, the kind and pH of the medium and other variable factors are given. Initial experiments showed that 40°C. was a convenient temperature for experimental purposes, the cultures being rendered sterile in about 45 minutes. These experiments also showed that for death the temperature characteristic is very high.

It can be demonstrated that the sterilization time is affected by pH, and that in the medium used the organism is most resistant at pH 5.0. The resistance at pH 5.0 is twice as high as at pH 8.0. This maximum of resistance is at a distinctly different pH from the pH of maximal growth in the same medium. The optimal initial rate of growth is at pH 6.7 but the cultures exhibit a type of Tammann effect in that the maximal amount of growth shifts with time to the alkaline range.

The sterilization time is also affected by the number of organisms per cc., the more concentrated cultures, in general, requiring a longer time to be rendered sterile. However, some of the dilute cultures, apparently a random selection, require as long a time for sterilization as the more concentrated ones. This is explained as being due to a very wide distribution of resistances among the organisms. The general relationship of sterilization time and concentration of organisms can be explained without the assumption of a protective secretion of the type that has been proposed by Dr. Allee for similar phenomena. Deductions based on the law of mass action and on the wide distribution of individual resistances can easily explain this relationship in *Euglena gracilis*, and also in the case of bacterial cultures (Jahn, 1929-1932).

The second group of experiments concerns the growth of *Euglena gracilis* in the dark at different temperatures. In a medium of hydrolyzed casein the optimal temperature is 10°C., and growth is very slow (less than one division in three weeks). However, when sodium acetate is added, the growth rate is greatly increased (to more than one division every two days), and the maximal amount of growth occurs at 23°C. instead of at 10°C. Without acetate, encystment occurred at 15°C. and above, but in the cultures containing acetate no encystment occurred during the time of the experiment.

In a series of experiments performed to determine the optimal concentration of ammonium acetate, it was found that the optimal concentration was different in the light (M/1280) and in the dark (M/160). It was also found that the optimal concentrations in the light and in the dark are higher for sodium acetate than for ammonium acetate, due to the lower toxicity of the sodium ion.

Further experiments showed that the acetate radical could be replaced by proprionate and better still by butyrate, but not by formate, lactate, citrate, oxalate, succinate, or tartrate.

(A summary of a seminar report presented at the Marine Biological Laboratory on August 23.)

NUCLEAR STRUCTURE AND MITOSIS IN ZELLERIELLA (OPALINIDAE)

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During the last few years, I have been interested in the mitosis and chromosome behavior among the opalinids which are a group of ciliates living in the large intestines of frogs and toads, although some species have been described from fishes, salamanders and reptiles. They are particularly interesting because ciliates in general possess two kinds of nuclei—the micronucleus and the macronucleus, but in the opalinids there is only one kind. There have been greatly divergent ideas concerning the nuclear structure and mitosis. It seemed necessary to work over the whole subject with an abundant supply of favorable material. Since the size of the nuclei in these animals varies a great deal in different genera and different species, it would seem best then to work on a species with very large nuclei so that the chromosomes and their behavior could be worked out in detail.

At the University of Pennsylvania, under the direction of Prof. Wenrich and Prof. McClung, I have obtained and studied opalinids from different parts of this country as well as from Mexico, Naples, Bermuda, British West Indies, and different parts of Asia. It was our intention to find a species with nuclei which would be large enough for our work and at the same time find living material which could be obtained in great abundance. After spending much time, we have finally discovered a species from the southern part of this country which seems to have fulfilled the purpose. A report is given on this form—a species of Zelleriella (opalinidae), although I have also studied other forms.

The main part of this paper is devoted to the behavior of chromosomes and chromosome individuality. Here we have a case in which the behavior of chromosomes in a Protozoan cell is most strikingly similar to the behavior of chromosomes in a Metazoan cell.

NUCLEAR STRUCTURE

During interkinesis or the resting stage, the nucleus is spherical, oval, or slightly elongated. There are three essential structures of interest in the nucleus: (a) The nuclear membrane which is persistent throughout mitosis as in the majority of Protozoa. (b) The chromatin reticulum which gives rise to chromosomes during mitosis. (c) Masses of material, which stain intensely with hematoxylin during interkinesis and in all stages of mitosis but disappear with Feulgen's technique. The nature of this material is not known.

NUCLEAR DIVISION

(1) Prophase. At early prophase, the fine chromatin reticulum begins to condense and transforms gradually into a fine spireme. At this stage, if not carefully studied, it might give one a false impression that it is a continuous thread. However, when it is examined carefully, the spireme appears to consist of a number of threads or chromosomes. Each chromosome could be studied, traced, mapped, and drawn. The chromosomes condense and become thicker and shorter as mitosis goes on and can be counted and studied more easily. At late prophase or early metaphase, the chromosomes tend to collect at the equator of the nucleus and aggregate there, meanwhile the nucleus has already become elongated.

(2) Metaphase. On account of their extreme condensation, the chromosomes in metaphase are the thickest and shortest and most intensely stained. The chromosomes do not seem to arrange themselves in a definite equatorial plate as in some animals but they do arrange themselves at the equator of the nucleus. Later, the longitudinal split of the chromosomes shows clearly and the chromatids or the daughter halves of each chromosome can be identified. At a somewhat later stage, the chromatids appear to be quite far apart from each other.

(3) Anaphase. In anaphase, the daughter halves of each chromosome move toward opposite poles. The daughter chromosomes do not reach the poles at the same time but apparently a number of them may be ahead of others in approaching the poles.

(4) Telophase. After reaching the poles, the chromosomes remain there and they become more irregular in arrangement, while the nucleus with its persistent nuclear membrane begins to constrict at the middle and as a result a dumb-bell shaped nucleus is formed. Constriction of the nucleus continues until two daughter nuclei are formed which are at first connected by a thread. The chromosomes in the meantime have been gradually transforming into chromatin reticulum within the daughter nuclei. At a later time, the connecting thread between the two daughter nuclei disappears, resulting in the formation of two free spherical nuclei.

Among the 24 or 25 chromosomes found there are certain individuals which could be readily recognized in every nucleus on account of their differential size. They are the six shortest chromosomes in the whole series. They are very much shorter than any other chromosomes in the whole group and hence they could be readily recognized.

In the resting stage, the masses of material within the nucleus may assume spherical, oval, elongated or similar shapes. There is no definiteness in shape and the number varies a great deal, from two to twelve in each nucleus. There are also considerable variations in size. Such variations in shape, size, and number may occur within the two nuclei of the same animal, either during the resting stage or mitosis. In no stage, do they show positive reaction with Feuglen's technique.

In the early prophase, a striking change takes place. They tend to become greatly elongated. In a late prophase, however, they seem to condense and shorten until they become very much condensed in the metaphase. In the anaphase, they become elongated again and constrict and divide in the middle. Division may be equal or unequal. Approximately half of the daughter masses go to each pole where they become elongated and later transform into spherical, oval, or elongated bodies in the resting stage.

DIVISION OF THE CELL BODY

Division of the cell body may take place in the metaphase, the telophase, or in intermediate stages. Nuclear division is usually accompanied by the division of the cell body but there are cases in which the division of the body is delayed, thus giving rise to specimens with four nuclei. There were cases in which the four nuclei were seen in division but no animals with eight nuclei have been observed.

SUMMARY

(1) A species of binucleated Opalinid has been studied with reference to the nuclear structure and mitosis, especially the behavior of chromosomes and chromosome individuality.

(2) During interkinesis, the spherical or slightly elongated nucleus contains a chromatin reticulum, which later gives rise to chromosomes, and a few masses of material which stain intensely with hematoxylin but disappear with Feulgen's technique. The nuclear membrane is persistent throughout mitosis as in the majority of Protozoa.

(3) Mitosis, which is similar to that of Metazoan cells, involves a transformation of the chromatin reticulum into a spireme, condensation and shortening of chromosomes, their collection at the equator of the nucleus, longitudinal splitting of the chromosomes, movement of daughter halves of chromosomes toward opposite poles and the gradual transformation of daughter chromosomes into chromatin reticulum of the daughter nuclei.

(4) There are certain masses of material in the nucleus which stain intensely with hematoxylin but disappear with Feulgen's technique. There is no definiteness in shape, size, and number in the resting stage or in any stage of mitosis. They show considerable reorganization during mitosis.

(5) Division of the cell body may take place at the metaphase, the telophase, or in intermediate stages. Cases in which the division of the cell body is delayed were also observed.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on August 23.)

COMMENTS ON THE SEMINAR REPORT OF MR. CHEN

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For Mr. Chen's paper on Zelleriella I have only words of admiration. He has used methods of preservation and of staining which seem entirely satisfactory for the chromosomes, and they were the structures which he was studying. His results outclass those previously reported and one feels complete confidence in them.

There is much further in the cytology of the opalinids to be studied. There is hardly a structure in the body which should not respond illuminatingly to such adequate technique as that Mr. Chen has employed for the chromosomes, though each structure may call for its own special methods. One waits with eager interest, for example for the report of the behavior of the several structures during the life history, especially during its presexual, sexual and post-sexual phases. But it will require much time to give such careful study to all of this. The nature and meaning of at present problematic structures may receive much light from their behavior.

INTENSITY DURATION RELATIONS IN THE RESPONSE OF CERTAIN PROTOZOA TO THE ELECTRIC CURRENT

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When a galvanic current is passed through a solution containing protozoa, most forms respond in some characteristic way. In *Amoeba proteus*, the outstanding reaction consists in orientation and migration toward the cathode. It is known that one of the main factors involved in locomotion of Amoeba is the continuous transformation of plasmagel to plasmasol at the posterior end and of plasmasol to plasmagel at the anterior end of the organism. One may ask, therefore; does the galvanic current, in causing this orientation and migration toward the cathode, act by changing the rate of the gel-sol transformation?

The Amoebae used were removed from a stock culture, washed several times in a synthetic solution, allowed sufficient time for adjustment, and then transferred to the solution in a rectangular glass trough, through which a galvanic current of known and readily controlled strength could be passed.

An attempt was made first to ascertain the intensity-duration relations in response by the effect produced on the rate of locomotion in Amoebae moving toward the cathode. The rate of locomotion of specimens was obtained by measuring the distance between outlines drawn by means of a camera lucida. The results obtained on ten specimens show (1) that the continuous passage of a very weak current caused an increase in the rate of locomotion which persisted for several minutes and then a decrease, and (2) that the stronger the current, the shorter the period of increased rate. The results obtained on ten other specimens show (1) that the sudden make of the current causes within 15 seconds a decrease in rate at the anterior end and increase in rate at the posterior end, resulting in contraction of the organism and (2) that the stronger the current, the greater the degree of contraction. These results do not show the effect of duration of stimulus on response.

In normal locomotion and in the experiments described above, the flow of the plasmasol was uniformly forward. However, if the current is made so that Amoeba moves toward the anode, the direction of flow of plasmasol is reversed at the cathodal end. The time which elapses between the stimulus and response (reversal of flow) is called the reaction-time.

A detailed study of the relation between current strength and reaction-time shows (1) that the reaction-time decreased as the current strength increased, (2) that a curve through the experimentally determined points (reaction-time) closely simulated an hyperbola, (3) that the quantity of current (it), where i is intensity and t duration, remained practically constant throughout the range of current strengths tested, and (4) that the value of the expression, $i\sqrt{t}$, was not constant as required by Nernst's law of electrical excitation for striated muscle but increased as the current strength increased. Nernst's law states that for equal stimulating effect the product of the intensity of the current and the square root of its duration is constant, ($i\sqrt{t}=K$). Experiments in progress show that the reaction-time is affected by such environmental factors as temperature, hydrogen-ion concentration, etc.

Knowing now that Amoeba has a reaction-time, the question arises: how long must the current pass in order to obtain a response? The reaction-time in numerous specimens was ascertained with various combinations of intensity and duration of stimulus. The results obtained show that the percentage of trials yielding response decreased as the duration of stimulus decreased and that the duration of stimulus needed to produce a certain percentage of response decreased as the current strength increased. They show also that the reaction-time was constant regardless of the duration of the stimulus and that the reaction-time was composed of two parts: a stimulation period, a time during which passage of current was necessary and a latent period, a time during which passage of current was not necessary in order to obtain a response. A study of the different phases of the reaction-time shows (1) that both the reaction-time and the stimulation period decreased as the current strength increased, whereas the latent period remained constant and (2) that the quantity of current (it) passed, remained practically constant throughout the range of current strengths tested. It seems, therefore, that a definite amount of current (it) is required to initiate response and that then a definite amount of time (latent period) is required to bring it to expression. Here again the value of Nernst's equation, $i\sqrt{t}$, was not constant but increased as the current strength increased.

The intensity-duration relations in the response of *Spirostomum ambiguum* to electrical stimulation are similar to those of Amoeba. When a galvanic current is passed through a solution containing Spirostomum, the forms lying parallel to the direction of the current, contract sharply. Owing to the almost instantaneous nature of the response, the reaction-time was not ascertained, but certain other relations were studied with various combinations of intensity and duration of stimulus. The results obtained show in Spirostomum, as in Amoeba, that the percentage of trials yielding response decreased as the duration of stimulus decreased and that the duration of stimulus needed to produce a certain percentage of response decreased as the current strength increased. They show also, as noted above for Amoeba, that the stimulation period decreased as the current strength increased. In Spirostomum, however, the quantity of current passed did not remain constant as in Amoeba but decreased as the current strength increased. Furthermore, the value of Nernst's equation does not remain constant; neither did it increase as the current strength increased as noted for Amoeba, but rather it decreased as the current strength increased. Apparently, the case with Spirostomum is more complex than that with Amoeba.

It appears therefore that in Amoeba we may be dealing with a basic protoplasmic response unaffected by specialized conducting and contracting elements, perhaps with a colloidal gel-sol transformation, whereas in Spirostomum we may be dealing with a similar basic protoplasmic response, or with a response conditioned by specialized conducting and contracting elements, or with a combination of both. More extensive experiments on these problems are now in progress.

(This article is based on a seminar report presented at the Marine Biological Laboratory on August 23.)

REGULATION OF IONS IN THE BODY TISSUES[1]

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The regulation of ions in the body tissues is a problem to be developed from two fundamental facts in comparative physiology. We know that the composition of ions in the body fluids is nearly constant. We find appreciable differences between the mineral content inside the cells and that of the outside solution. Furthermore, the composition of mineral substances varies in cells belonging to different organs so that we may say that the outside solution is in equilibrium with different solutions inside the cells. We know, further, from much experimental research that relatively small changes in the ionic composition of the outside solution lead to considerable changes in the function, or may even lead to the death, of the cell. Not only is the presence of certain mineral substances necessary to maintain life, but also a certain constant mixture of these ions is necessary for the maintenance of life and function. It may be considered that the supply of mineral substances from without in the higher animals, especially in man, is rather irregular, therefore, we must assume that there is a certain regulatory mechanism which keeps up the store and distribution of ions in the body.

The question arises as to what kind of regulatory mechanism accounts for this. First of all the excretory organs, the kidney in particular, can play an important part by increasing or decreasing the excretion of certain ions, but the power of these organs is limited. They may be able to regulate the whole store of mineral substances but they cannot influence directly the distribution of ions between the body fluids and tissues. Here we have to assume special kinds of regulatory systems. Not much is known on this question and we may better start with some general assumptions, the limits of which should include everything that may happen.

Three kinds of such regulatory systems may be described as follows: (1.) a regulation of ions based upon certain chemical properties of the fluid, i. e., a regulation of ions in a liquid system, based upon buffer substances; (2.) a system of two solutions separated by a membrane, i. e., the inside solution of the cell and the outside solution separated by the cell membrane; the distribution of ions may be due to the structure and permeability of the membrane which leads to certain ionic equilibria between the solutions; (3.) the exchange of ions between a liquid and a solid phase—between either the solution inside the cell and the cell structure, or the outside solution and the surface of the cell.

The regulation of the H ions in the blood based upon the buffer substances belongs to the first kind of regulatory system. It may be emphasized that this regulation must be completed by the action of the respiratory centre and the evidence leads to the assumption that also other regulatory mechanisms require a certain physico-chemical system connected with a special metabolism reaction to complete them.

The regulation of potassium by the muscle belongs to the second kind of system. I found that potassium enters the muscle if the concentration in the outside solution exceeds the normal threshold value, and that it leaves the muscle if the outside concentration is smaller than the normal value in the blood. The outside concentration of potassium therefore is regulated by the muscle. The muscle fiber is permeable to potassium and H ions and impermeable to Na, Ca and Cl ions (Mond and Amson). Every explanation of the regulation of K by the muscle has to deal with the fact that the concentration of K inside is about 20 times as high as that on the outside, and that K enters the muscle against the concentration gradient. Netter gave a sufficient explanation of the distribution of K inside and outside the muscle when he derived from model experiments in which he worked with artificial membranes of a similar permeability to the muscle fibers. The principle of such a distribution of ions against the concentration gradient under certain conditions applies to any system which consists of two solutions separated by a membrane which is selectively permeable only to one kind of ion. For instance, if blood corpuscles are suspended in a mixture of isotonic sugar and NaCl solution, the ratio of Cl inside over the Cl outside becomes greater than one. Sugar does not enter the erythrocytes, but keeps up the osomotic pressure in the outside solution. Chloride ions cannot leave the blood corpuscles in spite of the high concentration gradient be-

[1] This article came from Germany last week, and Dr. Mond asked us to edit it. We are under obligations to Dr. Robert Chambers who went over the manuscript for us.

cause the membrane is impermeable to cations. Only an exchange of Cl ions against other cations is possible and the ratio of anions on the inside over those on the outside follows the Donnan equilibrium. The value of this ratio depends upon the amount of sugar in the outside solution.

In the same way, if muscle fibers are surrounded by a solution of NaCl and small amounts of KCl, the osmotic pressure of the outside solution is chiefly accomplished by the NaCl which does not penetrate. K and H ions which are able to enter the muscle will be distributed according to Donnan's law: Ki/Ko=Hi/Ho. This ratio has normally a value of about twenty. If we increase the concentration of K in the outside solution, the equilibrium is disturbed and a new one has to be established by exchange of K outside against H ions inside. The opposite reaction occurs if we decrease the outside K concentration. The shift of potassium between fibre and surrounding solution leads to an effect which can be compared with the action of the buffer substances in the blood. The former value of the K concentration can be approached by the exchange, but a complete regulation cannot be accomplished by the physicochemical system alone. This can be made possible either by increasing the H ion concentration inside, so that the ratio of H inside over H outside becomes greater and more K ions are able to enter the muscle in exchange with H ions, or by decreasing the H ion concentration inside, thus enabling more K ions to leave the muscle. Chemical reactions are known which may increase or diminish the H ion concentration inside the fibre, i. e., the formation of lactic acid, or the breaking down of phosphocreatine.

The explanation of the regulation of the K ions is based upon the experimental discovery that in perfusing experiments K is regulated by the muscle, and on the conclusions drawn from experiments by Netter in which he investigated the distribution of ions between two solutions separated by a membrane with the properties of the muscle fibre boundary. However, it is necessary to show the quantitative exchange of K and H ions between muscle and surrounding fluid. We tried to perform that by perfusing frog muscles with unbuffered Ringer solution and analysing simultaneously the K and H ion concentration of the solution. We failed to find a quantitative relationship. The reason is that there is another buffer system between the muscle fibre and the outside solution which we did not expect and which makes it impossible to measure directly the amount of shifting H ions. If we perfuse with unbuffered Ringer's solution, the fluid coming out contains fairly large amounts of bicarbonate. The cation belonging to the bicarbonate is sodium which has been found by investigating the changes of the contents of ions in the perfusion fluid and in the muscle.

These results lead to a kind of ion distribution between cells and surrounding fluid quite different from the shift of K and H between muscle and blood. A relatively small amount of Na, up to about 30 mgr. per cent., belongs to the muscle fibre. There is, as we found, no relation between the Na concentration inside the muscle fibre and the outside concentration, which makes it impossible to assume that the distribution of sodium between muscle and outside fluid is a problem of diffusion and permeability. There is still another fact which is incompatible with the assumption of diffusion. It is that K penetrates the fibre. If Na was also able to enter the muscle we should expect an equal distribution of K and Na between muscle and outside fluid, but this does not occur. So we have to conclude that the sodium of the bicarbonate in the perfused fluid cannot come from the inside of the muscle but must come from the surface. It may be bound there in some chemical compound that is as yet unknown.

The physiological significance of the shift of sodium between muscle and blood seems to be that under certain conditions Na leaves the muscle as sodium bicarbonate. This reaction seems to be specific, so that buffer substances in the blood is increased. We found, further, that appreciable amounts of Na can be bound by the muscle, this reaction being connected with those chemical reactions which occur during recovery after exercise. If muscles are stimulated through the nerve until fatigue sets in, no changes occur in the Na content of the muscle during stimulation or for some time after. Lactic acid leaves the muscle as free acid and is bound by the buffer substances of the blood. During recovery the amount of sodium of the muscle increases. This can be explained on the basis of those chemical reactions which are connected with the recovery process. Lactate enters the muscle from the blood. A part of this is oxidized producing CO_2 which leaves the muscle. If we suppose the Meyerhof quotient, i. e., that the ratio of the whole amount of disappearing lactic acid over the amount of oxidized lactic acid, has the value of six, then six mols of entering lactate leave behind in the blood six mols of cations which are chiefly sodium. If one mol of lactic acid is burned, three mols of CO_2 are produced and diffuse into the blood, where they become bound to three mols of the cations to form sodium bicarbonate. This leaves an excess of three mols of cations which, either makes the blood more alkaline or is bound to some corpuscular elements. We found an increase of the Na concentration of the muscle during recovery and the connection of the shift of sodium between muscle and blood with these reactions seems to be reasonable. If the value of the Meyerhof quotient becomes three, no change of the sodium amount of the muscle is to be expected, because as much lactate disappears as CO_2 is produced. If the quotient becomes smaller than three, more CO_2 is formed than lactic acid disappears, and it may be possible that now a certain amount of Na would be removed from the muscle as sodium bicarbonate.

Our knowledge about the regulation of ions in the tissues is still in the beginning stages. The experimental results are at present not sufficient to state a general theory. But it seems to be that every regulatory mechanism consists of a certain physico-chemical system connected with a special cell reaction. The finding of these quantitative connections would lead to a better understanding of the relations between ion effects and metabolism.

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THE DEVELOPMENT OF LEUCOPOIETIC TISSUE IN AMBYSTOMA PUNCTUATUM

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The leucocyte of the urodele Amphibia displays in the finer details of its cytoplasm a striking type of organization. The most obviously distinctive feature is an aster, present in the non-dividing cell, which has at the focal point of its rays a somewhat vaguely delimited body, the centrosome, and near this, but not at the focal point, two small, sharply defined granules, the centrioles. The more central part of the aster is demarcated from the periphery by a distinct line, the capsule, and this whole region inside the capsule is sometimes termed the sphere. The Golgi apparatus consists of a number of plate-like bodies on the surface of the sphere. The chondriosomes are long slender filaments, and, where adjacent to the aster, they are oriented radial to its center. There are two variations of the leucocyte structure described above, the polymorphonuclear neutrophile with an irregularly lobed nucleus and paler cytoplasm, and the eosinophile, so-called from the staining reactions of the small spheres that are closely packed in the cytoplasm outside the aster. These two are probably developed as specializations of the first type, which in the adult is relatively much more numerous in the centers of leucocyte formation than in the connective tissue and the blood stream. In the present study the presence of an aster with capsule and centrosome have been relied upon for identification of cells differentiating along the line toward definitive leucocytes, a criterion which seems perfectly reliable since no other amphibian tissue cell contains this structure. In the adult Ambystoma leucocytes are normally formed largely in a thick layer of tissue just under the capsule of the liver, but there is also another locus of considerable extent along the aorta.

The earliest cells that are the progenitors of leucocytes are found in embryos of Harrison's stages 34 and 35, before the beginning of circulation. They occur in small number all along the body at the level of the lower border of the somite either actually within the somite or just outside it below the ectoderm. They are distinguished from other cells of the somite by being nearly spherical and containing an aster with typical centrosome and capsule. These cells, which may be provisionally termed primitive myeloblasts, are the only loose cells in the segmented part of the body of the embryo, with the exception of a few neuroblasts, The primitive myeloblasts digest their yolk grains and become actively amoeboid cells capable of phagocytosis of yolk grains and may then be termed the earliest functional macrophages. This stage is completed early and by stage 38 the embryo has very few primitive myeloblasts remaining. Progressive multiplication in later developmental stages decreases the size of these cells in common with those of all other tissues. These smaller cells of the macrophage, or mononuclear, type are capable of giving rise, by stage 40, on the one hand to eosinophiles or by differentiation in another direction to the polymorphonuclear leucocyte, the third adult type.

The primitive myeloblasts are probably derived only from differentiation of cells of the ventrolateral border of the somite, and the distribution of leucopoietic tissue in the later embryo and early larvae varies at different body levels according to the history of this part of the somite. In addition to cells that can differentiate into primitive myeloblasts, this region of the somite contains potential fibroblasts and chromatophores that are later to be located in the dermis, so that the term dermatome often applied to it is appropriate. During stages 36-38 the cells of the dermatome region loosen up and begin active proliferation by mitosis. As a result there is developed a sheet of cells, at first but one cell thick, extending ventrally from the outer ventral corner of the somite along the body wall, just below the ectoderm. Within this sheet and continuous with one another are fibroblasts, chromatophores and primitive myeloblasts. Other myeoblasts work their way from the somite to a position between the aorta and the cardinal veins, where in later stages they multiply to give rise to the aortic zone of leucopoietic tissue.

In a more anterior part of the body, at the level of the heart, liver and pronephros, there is a development of a similar sheet of cells on each side from the dermatome part of the somite. During stages 37 to 39 the myeloblasts, and their descendants, the early macrophages, multiply especially rapidly in the more ventral part of the sheet of dermis so that this region becomes what may be regarded as the first very active center of leucopoiesis. It continues to function in this manner up to stage 46, a time after other centers have developed, but in later larvae there is no greater concentration of leucocytes here than in other parts of the dermal connective tissue. This center of leucocyte formation in the dermis is directly in contact with the liver where it is opposite that organ, and at about stage 40, the actively amoeboid macrophages begin to migrate from the dermal leucopoietic center to the immediately adjacent position under the liver capsule. Here they apparently encounter conditions particularly favorable to their multiplication. Mitotic activity is very rapid and soon, by stage 46, there is formed a band of leucopoietic tissue several cells in thickness along each side of the liver. At about stage 40 in all parts of the embryo where leucocyte proliferation is proceeding rapidly the eosinophilic and polymorphonuclear types begin to differentiate from the earlier type, the macrophage, so that almost from its earliest development the perihepatic region is producing the same three types of cells that it develops throughout the life of the animal. In later larval life the two bands of perihepatic tissue extend toward each other ventrally and dorsally and ultimately form practically a continuous layer, but even in a larva a month after hatching the capsule is still much thicker at the sides, the points of its earliest origin.

The development of the dermatome part of the somite is somewhat different in the tail region and is especially deserving of attention since the only other observations on the development of leucocytes in urodele Amphibia have been made on this part of the embryo. The intermediate and lateral plate mesoderm cease abruptly at the posterior limit of the cloaca and the only mesoderm growing out into the developing tail bud belongs to the somites. The early tail, stage 35, contains at its growing tip the neural tube and notochord and, immediately below the latter, a solid plug of endoderm tissue, continuous with that of the gut anteriorly. The somites of the two sides form solid masses and are continuous ventrally below the strand of endoderm and in close contact with it. The region where the somites of the two sides are continuous includes those cells which are the equivalent of the ventro-lateral (dermatome) region of more anterior somites and it is accordingly destined to form the same tissues in the tail. As the tail flattens out, stage 36, this ventral region breaks away from the rest of the somite and remains in contact with and partially surrounding the mass of endoderm. Later, as we should expect, fibroblasts, chromatophores, and primitive myeloblasts differentiate from this tissue surrounding the plug of endoderm under the notochord. Dr. and Mrs. Clark have studied what I consider must be this region in the Axolotl larva and have noted in the living animal the breaking away of cells from this ventral strand and their differentiation into these three types. Furthermore they have followed the development of the primitive myeloblasts as they lose their yolk and become actively amoeboid, functional macrophages.

Although before stage 46 the embryo contains probably thousands of the three definitive adult leucocyte types in the dermis, around the aorta, and in the periphepatic zone the blood stream has been almost completely deficient in them. But at about this time the macrophages, polymorphonuclears and eosinophiles suddenly begin to enter the blood in considerable number so that very soon they constitute from 1 - 2% of the cells of the blood, a condition approximating the adult blood picture.

In conclusion let me briefly point out the features of this study that are perhaps of considerable significance to the general problem of blood cell formation in vertebrates. The leucocytes arise before circulation has begun in a region remote from the ventral blood island region, where the erythroblasts are developing, and far distant from any blood vessel anlage. Their place of origin in the somite is practically identical with that of the connective tissue cells of the dermis and for some time they proliferate only in the region of the dermis. Only after thousands of these leucocytes of the three specialized definitive adult types have been developed extravascularly do they enter the blood stream and mingle with the erythrocytes, which have always been intra-vascular. This sequence of events perhaps suggests that the leucocyte is primarily not a blood cell but a connective tissue element that is only secondarily inside the blood stream. Furthermore, these observations on leucopoiesis in the embryo and early larva offer no support for the widely prevalent view that in the Amphibia leucocytes and erythrocytes are derived from an identical stem cell, the hemocytoblast.

(This article is based upon a seminar report presented at the Marine Biological Laboratory on August 30.)

PIGMENTATION IN THE HYPOPHYSIS AND PARATHYROIDS OF THE GRAY RAT

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Melanotic pigmentation of internal organs is a comparatively rare phenomenon in mammals. In the gray rat, both wild and captive, there is melanotid pigment in the hypophysis in the majority of cases studied, and occasionally in the parathyroids. In the hypophysis it is never equally distributed throughout all regions of the organ, but is usually restricted to one part. This is most commonly the pars intermedia. In some cases it is found only in the pars distalis glandularis. The parathyroids may be pigmented in the presence or absence of pigment in the hypophysis. A more complete account will appear in the August number of the *Journal of Comparative Neurology.*

(An abstract of a seminar report presented at the Marine Biological Laboratory on August 30.)

LOG OF THE INVERTEBRATE COURSE

The student who has met the marine invertebrates through a study of preserved specimens has had but an incomplete picture of the group, a blurred glimpse through a keyhole. The aim of the course in invertebrate zoology at Woods Hole is to introduce the student to the living forms in the laboratory, and to the animals in their native habitats. For him who uses seeing eyes, these invertebrates soon become living, active organisms busy about securing food, dwelling amicably with or protecting themselves against their neighbors, overcoming or adapting themselves to barriers, insuring themselves against extinction, repopulating the waters with their kind. In the laboratory, through the study of fundamental similarities and superficial differences in a wide variety of genera in each class, the entire group gradually assumes a phylogenetic significance, so that the interrelationships of invertebrates through time as well as their present-day diversity and distribution in space appear in proper perspective.

Dr. Elbert Cole, as successor to Dr. J. A. Dawson, has managed the course this year, retaining the former staff with the addition of Dr. S. A. Matthews, as junior instructor. The class has numbered fifty-five. Dr. B. R. Coonfield opened the course with a two-day study of Protozoa, which, in spite of its brevity, gave opportunities to observe many fresh, brackish and salt-water forms. The Suctoria, Acineta and Ephelota, and several of the Heliozoa and shelled Rhizopoda proved themselves, as usual, to be general favorites. The next day, following a lecture on marine ecology by Dr. L. P. Sayles, the class enjoyed the treat, given this year for the first time, of a field trip to Cuttyhunk, where some of the names on the check-list began to call forth images of living animals.

The group Porifera was introduced by Dr. L. P. Sayles. Living Grantia and Leucosolenia were studied, and regeneration in Microciona was watched from cells which had been dissociated by squeezing the sponge through bolting cloth. Dr. O. E. Nelson, who had charge of the work on the Coelenterata, gave out nine hydroids as "unknowns" with a key by which they could be identified. Then came the trip to Vineyard Haven, where the class rowed among the wharf-piles, saw through glass-bottomed buckets the Mytili, Metridia, hydroids, Bryozoa, and Protochordates in their brilliant natural clusters, scraped the piles and went ashore to examine the scrapings. In the laboratory, giant Metridia were available for observation while contracting or expanding, moving their tentacles, feeding or rejecting food, and shooting out acontia when irritated. Living Gonionemus excited its usual share of admiration, and Mnemiopsis proved, to some at least, to be as interesting when viewed by day as by night.

To continue our studies Dr. A. W. Pollister presented the class with a variety of Platyhelminthes including Planaria to be cut for regeneration experiments, Bdelloura, Trematode in various stages of development from redia to adult; scolices, proglottids and hexacanth embryos of Cestodes; and Metenchalaimus, as an active representative of the Nemathelminthes.

As a break in this intensive work in the laboratory, the class spent a busy day at Hadley Harbor, where students made the acquaintance of some of the mud, sand and rock-dwelling associations, brought up populated stones en route through the gutter, hunted on hands and knees for Melampus, and appreciated the famous Mess sandwiches. The shovels moved fast in quest of Diopatra and Arenicola; sieves were shaken vigorously; hand-nets scooped up crabs and other Crustacea; the Thyone bed was visited and left undisturbed; and the arks were brought back well filled, with a total of 155 different species. From the fruits of this trip an exhibition was set up in the lobby of the Brick Building of the Marine Biological Laboratory. Almost as many forms were taken at Kettle Cove, where the shore is more exposed than at Hadley Harbor and where brackish pools are teeming with oysters, hermit-crabs and worms. On this trip some of the more venturesome students made their way out to "Nelsen's Island," a group of large rocks covered with starfishes, sea urchins and corals.

Three days were spent on the study of the Annelida, under the direction of Dr. Sayles. Twenty-one different species of worms, unlabelled and accompanied by a key, were available for identification, for observation of swimming movements and tube-building, and for a comparative study of heads. Dissections of fresh specimens of *Arenicola cristata* gave a conception of an intricate blood system in action.

The calmness of the Vineyard Sound made the dredging trip a pleasure, for even the most land-loving could watch the dredge at work and examine the material in physical comfort. Some of the typical deep-water forms were met here: Pseudopotamilla, the parchment-tube worm; Dodecaceria and other annelids; *Modiolus modiolus;* Barentsia, a rather rare bryozoan; the bizarre crab, *Heterocrypta granulata.* The prize find of the day was Corynitis, a tiny hydroid which lives in association with Schizoporella.

With Dr. T. H. Bissonnette, the class spent one day on the Bryozoa, identifying different species by means of a key and studying their structure and activities. The Echinoderms also are being presented by Dr. Bissonnette, who has again repaired the clay models of the water-vascular system and of Aristotle's lantern. In this laboratory work, many people have met for the first time the star-fish, sea urchin and brittle-star in action, watched their ways of feeding, of righting themselves, of moving from place to place. It has been a privilege to know living Thyone and Leptosynapta.

Three groups remain to be studied before the close of the course, the Arthropoda, given by Dr. Cole, the Mollusca by Dr. A. E. Severinghaus and the Protochordata by Dr. Coonfield. Trips to Nobska and North Falmouth, and of course, the class picnic, are still in anticipation. Under the management of Dr. Cole, and with the weather kindly disposed toward field trips, the course has progressed smoothly. Without doubt, all of those who have been privileged to meet the marine invertebrates in this way will leave Woods Hole feeling that they have broadened their acquaintance with these animals, and have come to know, at least, some of them, in an intimate way.

—*E. K. P.*

HEATH HEN REPORT — 1931-1932

Dr. Alfred O. Gross
Professor of Biology, Bowdoin College.

The following report of the heath hen situation for the year 1931-1932 is made under the auspices of the Massachusetts Division of Fisheries and Game.

On April 1, 1931 the last heath hen was trapped on the James Green farm and marked with two metal bands. An aluminum band number 407,880 was placed on the left leg, and a copper band, number A-634,024, was fastened to the right tarsus. The bird returned to the vicinity of our blind on the following day apparently none the worse for its experience and continued to visit the traditional "booming or courting" field at regular intervals until May 9, 1931. The bird failed to make its appearance during the remainder of the year. On February 9, 1932 the bird unexpectedly and dramatically appeared on the Green farm after an interval of nine months, to announce to the world that it was still alive. Thereafter the bird was seen at regular intervals until March 11, 1932, but it seldom came to the exposed center of the field as it did in the past years and consistently kept itself close to the dense scrub-oak cover. Perhaps a harrowing experience with some predatory hawk or mammal has made this wary creature even more cautious. Thomas A. Dexter of Edgartown claims to have seen the bird when he passed the Green farm on the morning of April 6 and Edward T. Vincent also of Edgartown reported it as being in the scrub oaks two miles east of the Green farm on July 18. Neither of these two reports have been substantiated.

This "last bird" has been alone since December 1928 and is at least nine years old as there have been no young heath hen since the summer of 1924. The history of the heath hen and the various factors involved in its decline have been fully considered in previous reports, but it will be of interest to those who have not followed the status of this species to review the numbers of birds as recorded in the annual official census reports. The birds were at their height in 1916 as far as their recent history on Marthas Vineyard is concerned. In the early Spring of that year over 800 birds were counted and an estimate as high as 2000 was made by the warden in charge. The following table reveals the rapid decline of the heath hen from 1916 to the present time.

1916, 800 birds; 1920, 314; 1921, 117; 1922,

MARINE BIOLOGICAL LABORATORY CHEMICAL ROOM

Formulae and Methods II.

Edited by OSCAR W. RICHARDS

This supplement to the original list[1] gives corrections to that list and additional formulae and information. The material is planned for the use of the staff of the Chemical Room and is collected and prepared by various members of the staff. We are indebted again to several investigators for additional formulae and helpful advice regarding the material. The favorable reception of the previous list has encouraged us to publish occasional supplements and the editor wishes to extend an invitation to the biologists of the M. B. L. to bring to his attention any errors in the published lists and any formulae and methods that might be included in future supplements.

CORRECTIONS to the original list.

Table 2, **Benda's Fluid**—aq. dest. 15 cc., glacial acetic acid 3-6 drops, *chromic acid* 0.15 *g., 2%* osmic acid 4 cc.

Table 3, **van't Hoff Sol.** Artificial sea water. sodium chloride 19.0 g., magnesium chloride 2.4 g., magnesium sulphate 1.5 g., potassium chloride 0.53 g., calcium chloride 0.37 g., *anhyd. salts* dissolved and made up to 1000 cc. *with glass distilled water.*

Table 6, 3. **Normal Sodium Hydroxide** 1000 ml. contain 40.01 g. . . .

NEW MATERIAL

Table 1, GENERAL INFORMATION.

Accuracy and errors. Absolute errors x_1-X are deviations from the correct values and their sign is important for correct statement. They are expressed as correct to two decimals, or to the nearest million, etc. Absolute errors are more important in addition and subtraction; *e. g.*, In a column of figures the absolute errors in the third place of a sum or a difference may be great enough to make the second place unreliable. Relative errors $(x_1-X)/X$ are connected with the number of significant figures and are usually expressed as percentages. These errors are important in multiplication and division. In a product or quotient the number of significant figures is equal to the number in the weakest factor. Many solutions need not be prepared more carefully than 5% while others must be made with care to insure sufficient accuracy. If in doubt as to the precision required consult with the investigator or with the person in charge. This information and that given previously (*q. v.*) is to be used as a guide by the staff in the use of the equipment in the Chemical Room.

A **molal solution** (m) contains one gram-molecular weight dissolved in 1000 grams of solvent. For ordinary aqueous solutions 1 ml. of water is used as 1 gram. For other solutions calculate according to density at the temperature used.

A **molar solution** (M) contains one gram-molecular weight in one liter of solution. Dissolve the material in less than one liter and make up to one liter in a volumetric flask.

A **normal solution** (titrametric) contains one hydrogen equivalent of the active reagent in grams in one liter. The equivalent in grams may be defined as that quantity of the active reagent which contains, replaces, unites with, or in any way, directly or indirectly, brings into reaction one gram-atom of hydrogen. It may or may not be the same as a molar solution.

Percentage solutions. Percent. means parts in one hundred parts. These solutions may be made up according to weight, volume, or any combination of these. Many substances, *e. g.* alcohol, vary in strength according to percent by weight or by volume. Many aqueous solutions used by biologists can be made by adding 100 ml. of water to the weight of the solute without serious error although the resulting solution is not accurate. This should not be done when the resulting error is greater than 3% (*Cf.* sections on accuracy). Percentage solutions (by weight) may be prepared conveniently with a solution balance. Place the bottle, or bottle and funnel, on the pan and balance by means of the weight on the ungraduated beam. Set the weight on one of the graduated beams and weigh out the solute, then set for the amount of the solution and add the solvent until the scale is balanced. The beams are graduated to facilitate the preparation of percentage solutions but the balance may be

[1] Copies of the original list Collecting Net Suppl. V. Aug. 30, 1930 may be obtained from the Collecting Net office.

used to advantage for the preparation of other solutions.

The **dilution of percentage solutions** (aqueous solutions by weight) can be accomplished easily by taking the number of ccs. (*or multiples thereof*) of the stock solution equal to the strength solution desired and adding enough distilled water to make the total number of ccs. equal to the strength of the stock solution. Examples: (*a*) to prepare 7.1% from 18% stock solution use 7.1 ccs. of the stock sol. plus 10.9 ccs. water which makes a total of 18 ccs. (*b*) To obtain a 0.02% solution from a 0.4% stock solution use 1 cc. of stock solution (50 x .02) and 19 cc. water (50 x .38) making 20 cc. (50 x .02+50 x .38)=(50 x .4) of the required solution.

Table 2, KILLING AND FIXING FLUIDS.

Copper acetate formalin — Saturated cupric acetate in 40% formaldehyde. Dilute to about 4% for preservation of green algae.

FAA (General Biological Supply House)—50% alcohol 100 cc. 40% formaldehyde 6½ cc., glacial acetic acid 2½cc.

Navaschin's Fluid—10% chromic acid 1.5 cc., glacial acetic acid 1 cc., formaldehyde (40%) 0.83 cc., aq. dest. 32.67 cc.

Susa—aq. dest. 80 cc., mercuric chloride 4.5 g., sodium chloride 0.5 g., trichloracetic acid 2.0 g., formalin 20 cc., glacial acetic acid 4 cc.

Worcester's fluid. 10% formalin saturated with mercuric chloride, 90 cc., glacial acetic acid, 10 cc.

Table 3, GENERAL FORMULAE.

Brodie's sol. aq. dest. 500 cc., sodium chloride 23 g., sodium choleate 5 g., 1% methylene blue 3 cc., thymol 0.1 g.

Cement—Beeswax 58%, rosin 29%, Venetian turpentine 13%.

Chalkley's medium. aq. dest. 1000 cc., sodium chloride 0.1 g., potassium chloride 0.004 g., calcium chloride 0.006 g.

Fieser's fluid. aq. dest. 100 cc., sodium hydrosulphite 16 g., sodium hydroxide 13.3 g., sodium anthraquinone β sulphonate 4 g.

Glycerine jelly—water 42 cc., gelatin 6 g., glycerine 50 cc., phenol (cryst) 2 g. Soak 30 min., dissolve with gentle heat, add 5 cc. egg white and heat to 70°. After ppt. albumen removes the dust etc. filter through moist hot flannel. Add glycerine and phenol and stir while warm not over 75°) till homogeneous.

Green filter solution—water 300 cc., copper sulfate 35 g., potassium dichromate 3.5 g., sulfuric acid conc. 1 cc.

Heat absorbing fluid—water 1000 cc., Mohr's salt (ferrous ammonium sulfate) 200 g. Dissolve and filter and if not perfectly clear add 1.7 cc. conc. sulphuric acid.

Ripart-Petit medium—camphor water (not satd.) 75 cc., aq. dest., 75 cc., cryst. acetic acid 1 g., copper acetate 0.3 g., copper chloride 0.3 g.

Table 5, STAINING SOLUTIONS.

Borrel—A. 1% aqueous magenta (basic fuchsin). *B.* 1 g., indigo carmine, 60 cc. dist. water, 30 cc. satd. picric acid.

Table 7, HYDROGEN ION STANDARDS AND BUFFER SOLUTIONS[2].

Prepared by EDWIN P. LAUG.

7. Indicator Solutions

Indicator[3]	pH Range	0.1 N NaOH per gram dye	0.04% dye Soln. per 10 ml. buffer
Thymol Blue	1.2 - 2.8	21.5 ml.	1.0 ml.
Brom Phenol Blue	3.2 - 4.6	14.9	0.5
Brom Cresol Green	3.8 - 5.4	14.3	0.5
Chlor Phenol Red	5.0 - 6.6	23.6	0.5
Brom Cresol Purple	5.4 - 7.0	18.5	0.5
Brom Thymol Blue	6.0 - 7.6	16.0	0.5
Phenol Red	7.0 - 8.6	28.2	0.25[4]
Cresol Red	7.4 - 9.0	26.2	0.25[4]
Meta Cresol Purple	7.4 - 9.0	26.2	0.5
Thymol Blue	8.0 - 9.6	21.5	0.5

[3] The preparation of these solutions is given in the previous edition: section 1, p. 10.
[4] Be sure to mark conc. of solution on these sets since these indicators are often diluted to 0.02%.

8. Clark and Lubs' Phosphate Buffers pH 5.6—8.0

Ref.—Clark, W. M., The Determination of Hydrogen Ions, 3rd Edition. Chapter IX, Table 35.

Ordinarily the stock solutions consist of 0.200 M KH_2PO_4 and 0.200 M NaOH, to be mixed in appropriate proportions and made up to 200 ml. Since large quantities of these buffers are used, it may be convenient to prepare 500 ml. instead of 200 ml. For this purpose the stock solutions of NaOH and KH_2PO_4 are made 1.000 M respectively and the table recalculated on this basis.

Stock Solutions

(a) 1.000 M NaOH for preparation *cf.* table 3.

(b) 1.000 M KH_2PO_4. Dry Merck's Potassium Phosphate, Monobasic, Anhydrous in an oven for 2 hrs. at 110° C. and place in a dessicator. Weigh out accurately 136.160 gms., dissolve, and dilute to exactly 1 liter in a volumetric flask. Mix as indicated in the following table and dilute to 500 ml. in a volumetric flask.

[2] This corrects and extends the same table of the previous edition. c. f. the introduction to this table in the earlier pamphlet for assignment and general comments.

pH	1.000 M KH_2PO_4	1.000 M NaOH
5.8	25 ml.	1.63 ml.
6.0	25	2.82
6.2	25	4.275
6.4	25	6.30
6.6	25	8.87
6.8	25	11.80
7.0	25	14.77
7.2	25	17.45
7.4	25	18.67
7.6	25	21.37
7.8	25	22.585
8.0	25	23.425

9. **Clark and Lubs' Borate Buffers** pH 7.8—10.0
Ref. - Clark, W. M., Ibid.
Stock Solutions

(a) Mixture of 0.200 M Boric Acid[5] and 0.200 M Potassium Chloride. Boric Acid is best dried in thin layers over $CaCl_2$ in a dessicator. The KCl may be dried in the oven at 120° C for 4 hours. Weigh out accurately 12.4048 gms. Boric Acid and 14.912 gms. KCl, dissolve and dilute to exactly 1 liter in a volumetric flask.

(b) 0.200 M NaOH. This is best prepared by diluting 1 part 1.000 M NaOH with 4 parts CO_2 free water. Mix as indicated in the table (section 5 p. 11) in the previous edition, and dilute to 200 ml. in a volumetric flask.

10. **McIlvaine Buffers** pH 2.2—8.0
Ref. - Clark, Ibid. Page 214.

Ordinarily the stock solutions consist of 0.200 M Disodium Phosphate and 0.100 M Citric Acid to be mixed in the appropriate proportions to give 20 ml. buffer. Since larger quantities of these buffers are used, it is advantageous to prepare 200 ml. instead of 20 ml. For this purpose the stock solutions of Citric Acid and Na_2HPO_4 are made 0.500 M and 1.000 M respectively and the table recalculated on this basis.
Stock Solutions.

(a) 0.500 M Citric Acid. Weigh out 105.055 gms. Citric Acid ($C_6H_8O_7H_2O$). Dissolve and dilute to 1 liter in a volumetric flask and standardize with 1.000 M NaOH. The titration is carried to a distinct red color of the phenolphthalein indicator.

(b) 1.000 M Na_2HPO_4. Dry Merck's Sodium Phosphate, Secondary, Anhydrous in an oven for 2 hrs. at 110° and place in dessicator. Weigh out accuracy 142.0275 gms., dissolve and dilute exactly to 1 liter in a volumetric flask.

Mix as indicated in the following table and dilute to 200 ml.

[5] Boric Acid should not be heated in the oven above 50° C, otherwise it loses "water of constitution."

pH	1.000 M Na_2HPO_4	0.5000 M Citric Acid
2.2	0.80 ml.	39.2 ml.
2.4	2.48	37.52
2.6	4.36	35.64
2.8	6.34	33.66
3.0	8.22	31.78
3.2	9.88	30.12
3.4	11.40	28.60
3.6	12.88	27.12
3.8	14.20	25.80
4.0	15.42	24.58
4.2	16.56	23.44
4.4	17.64	22.36
4.6	18.70	21.30
4.8	19.72	20.28
5.0	20.60	19.40
5.2	21.44	18.52
5.4	22.30	17.70
5.6	23.20	16.80
5.8	24.18	15.82
6.0	25.26	14.74
6.2	26.44	13.56
6.4	27.70	12.30
6.6	29.10	10.90
6.8	30.90	9.10
7.0	32.94	6.06
7.2	34.78	5.22
7.4	36.34	2.66
7.6	37.46	2.54
7.8	38.30	1.70
8.0	38.90	1.10

Table 8, PHOTOGRAPHIC SOLUTIONS.
For further information see "Elementary Photographic Chemistry" published by the Eastman Kodak Co.

Acid hardener stock solution (F-la) — water (52°) 1700 cc., sodium sulfite 480 g., glacial acetic acid 420 cc., potassium alum powd. 480 g., cold water to make 4 liters. Use 1 part hardener stock to 8 parts of 25% hypo solution. Stir while adding.

Chromium intensifier (In-4)—potassium bichromate 90 g., hydrochloric acid conc. 64 cc., water to make 1000 cc. Bleach negative in 1 part stock soln. to 10 parts water, wash 5 min. and redevelop in strong light with D-72 diluted 1:2. Then wash thoroughly.

Clearing solution—3% citric acid. Use just before the completion of washing the negative.

Film cement—amyl acetate and acetone in equal parts. May be used on both acetate and nitrate film.

Fine grain developers. (Agfa 12) water 960 cc., metol 8 g., sodium sulfite (anhyd.) 120 g., sodium carbonate (monohyd.) 6 g., potassium bromide 2.5 g. Develop 15-17 min. at 18° C. (65° F.).

Fine grain developer (Agfa 14)—water 960 cc., metol 4.9 g., sodium sulfite (anhyd.) 90 g., potassium bromide 0.5 g., sodium carbonate (monohyd.) 1 g. Develop 12 min. at 18° C.

Fine grain developer (DuPont NF1)—metol or elon 2.5 g., hydrochinone 3 g., sodium sulfite (anhyd) 75 g., borax 5 g., water to 1 liter. Develop 8-12 min. at 18°.

Fine grain developer (DuPont NF2) — Paraphenelenediamine 11 g., sodium sulfite 60 g., borax 27 g., trisodium phosphate 23 g., water to 1 liter. Develop 20 min. at 19°.

Fine grain developer (Gevaert GD203)—metol 1.2 g., sodium sulfite 60 g., hydrochinone 1.7 g., resorcine (metadioxyd benzolum) 1.2 g., borax 1.2 g., water to 600 cc. Sol. 1. Dissolve metol in 120 cc. water at 50°. Dissolve 13 g. of anhyd. sodium sulfite in a separate 120 cc. of water, to which the hydrochinone and resorcine are added. This last solution is then added to the metol solution.
Sol. 2. The rest of the sulfite and the borax are dissolved in 210 cc. of water at 70°. When cold this solution is poured slowly into solution 1 while the latter is stirred. Then add water to bring the bulk up to 600 cc. Develop 8 min. at 17°.

Fine grain developer (Gevaert GD-205)—metol 2 g., sodium sulfite 135 g., hydrochinone 6 g., borax 2 g., water to 960 cc. Develop 20 min. at 20°.

Glycine developer—water 1000 cc., sodium sulphite (dry) 6.2 g., glycine 2.1 g., sodium carbonate (dry) 6.2 g. Develop 30-35 min.

Positive film developer (DuPont)—sodium sulfite 60 g., metol 1.4 g., hydrochinone 4.8 g., sodium carbonate 48 g., potassium bromide 1.6 g., water to 1 liter. Time 4-6 min.

Positive film developer (D-11) — water (53°) 500 cc., elon 1 g., sodium sulfite 75 g., hydrochinone 9 g., potassium carbonate or sodium carbonate 25 g., potassium bromide 5 g., dissolve in order and then add cold water to make 1000 cc. Develop 4 to 6 min. For less contrast dilute one-half and increase time of development.

Proportional reducer (R-5)—*A.* water 1000 cc., potassium permanganate 0.3 g., sulphuric acid conc. 16 cc. *B.* water 3000 cc., ammonium persulfate 90 g., Use 1 part A to 3 of B. Clear negative after suitable reduction in 1% sodium bisulphite and then wash.

Stain remover (S-6)—*A.* potassium permanganate 5.3 g., water to make 1000 cc. *B.* sodium chloride 75 g., sulphuric acid (conc.) 16 cc., water to make 1000 cc. Use equal amounts of *A* and *B.* Bleaching should be complete in 2-4 min. Immerse in 1% sodium bisulphite to remove brown stain. Rinse well, develop in strong light with D-72 diluted 1:2.

Table 9, OSMIUM AND PLATINUM CONTAINING FLUIDS[6]

Prepared by JAMES B. LACKEY

Osmium and platinum fixatives are costly and often do not keep well. Few cytologists use the same formulae, each usually wanting his favorite formula, hence it is best to keep on hand certain stock solutions, among which are small amounts of osmic acid and platinic chloride. Below are listed certain fixatives containing one or both of these reagents, also a list of stock solutions. The makeup of the fixatives from the stock solutions is given in *parts by volume,* and the amount desired by an investigator can be made up to the nearest multiple of the total parts indicated.

Stock Solutions

Acetic acid, glacial	Osmic acid, 2%[7]
Chromic acid, 1%	Picric acid, sat. aq. soln.
Chromic acid, 1% in 1% NaCl	Platinic chloride, 10%
Formic acid	Potassium dichromate, 10%
Mercuric chloride, sat. soln. in hot water	
Mercuric chloride, 0.5% in 1% chromic acid	

Fixatives

Some of the fixatives listed below keep well and may be kept for a long time. Those which deteriorate are noted. All of these formulae are from *Lee's Vade Mecum* 9th ed. unless otherwise stated.

In making Osmic acid wash off the paper covering of the glass ampoule; rinse in distilled water, and file notches around the tube. Drop the ampoule into a clean, glass stoppered bottle of a capacity greater than the amount of osmic desired. The tube of osmic crystals may now be broken open with a heavy glass rod. As many tubes as wanted may be crushed inside the glass bottle but not over 200-300 c.c. of 2% should be kept in solution.

All osmic acid and fixatives containing it should be kept in bottles with well fitted glass stoppers. Osmic acid reduces slowly in the light and at high temperatures; when it is issued it should be in a brown bottle or the bottle should be covered with black paper to protect the contents from the light. The labels should be in India ink or pencil and not paraffined. When issuing these fixatives the label should indicate definitely which one it is, or its composition; since there are at least four Flemming's and three vom Rath's solutions.

6 Tables are numbered consecutively with the previous list.

7 In some laboratories (U. of Penn.) the osmic is made up in chromic acid solution and then will not deteriorate. This will change proportionately the amounts given in the table.

Name of Fluid	Water	Osmic Acid 2%	Platinic Chloride 10%	Chromic Acid 1%	Chromic Acid 1% in 0.5% NaCl	Potassium Dichromate 5%	Formic Acid	Acetic Acid, glacial	Satd. Picric Acid	Mercuric Chloride 0.5% in Chromic Acid 1%	Hot satd. aq. Mercuric Chloride	Remarks
Composition in Parts by Volume												
Altman	..	1	..	..	..	1	..	..	..	..	..	Best prepared when ready for use.
Benda	..	4	..	15	..	..	..	3-6 Drops	..	..	..	Keeps well
Champy	3	4	..	7	..	4	..	..	..	..	..	Keeps well
Guthrie	..	4	..	15	..	..	1	..	..	..	..	Will only keep a few hours.
Hermann[1]	13.5	4	1.5	..	..	..	..	1	..	..	..	Will keep indefinitely.
Hoehl	21	5	..	..	..	24	..	1	..	..	..	Doesn't keep very well
Strong Flemming	..	4	..	15	..	..	..	1	..	..	..	Keeps for weeks. Both Flemmings frequently made without acetic acid[2]
Weak Flemming[3]	70	5	..	25	..	..	..	0.1	..	..	..	
Lindsay Johnson	9.7	2	.3	..	..	7	..	1	..	..	..	Add acetic or Formic just before using.
Lee	..	12½	5	..	..	..	..	1	100	..	..	Keeps well
Merkel, Smith's mod.[4]	99.5	..	0.5	10	..	..	..	5	..	..	..	None too stable
Merkel[4]	34.5	..	0.5	5	..	..	..	..	..	..	..	
Meves	..	4	..	..	15	..	..	3–4 Drops	..	..	..	
Nassonow	..	2	..	2	..	2.4	..	..	..	..		
Podwyssozki	..	4	..	..	..	..	..	6–8 Drops	..	15	..	Keeps well
Vom Rath	..	10	..	..	..	..	..	1	50	..	50	Keeps well
Vom Rath[3]	..	6	..	..	..	..	..	1	100	..	..	Keeps well
Vom Rath	..	..	.5	..	..	..	..	1	100	..	..	Keeps well

1 Guyer, M. F., Animal micrology 1927 gives a different formula.
2 McClung, C. E., Microscopical technique. 1929. gives a different formula.
3 This is the more commonly used formula.
4 From McClung[2].

Table 10, MISCELLANEOUS INFORMATION

1. Compressed gases.[8]

An asterisk (*) indicates that special valves and fittings are required which are to be obtained from the Apparatus Room, 216 Brick Bldg. The purities are taken from letters received from the manufacturers and indicate only average purity bcause of the variation in different lots of gas.

Carbon dioxide. Tanks painted with aluminum paint. Available in 20 lb. cylinders* at 1000 lbs. sq. in. "truck size tanks" with 12 cu. ft. and "lecture bottles" with about 4 oz. of gas. These last two are filled to about 800 lbs. pres-

8 The distinguishing colors given hold only for the M. B. L. and for the companies mentioned and are not used universally in the U. S. A.

sure at the M. B. L., do not require any special reducing valve and are issued with hose nipple and handle lever. From Liquid Carbonic Corp., 136 Broadway, Cambridge, Mass. Purity 99.9% CO_2, 0.1% air. Moisture 0.01% and acidity as HCl less than 0.001% by weight.

*Hydrogen**. Tanks painted black and with square bases contain 140 cu. ft. at 1800 lbs pressure*. From Ohio Chemical and Mfg. Co., 231 East 51st St., N. Y. C. Purity 99.9+% H_2 with slight impurities of oxygen and water vapors. Hydrogen may not be sent by boat freight.

*Nitrogen**. Tanks painted grey with black band around top (water pumped) contain 110 cu. ft. at 1800 lbs. pressure*. From Linde Air Products Co., Elizabeth, N. J. Purity 99.7% plus or minus .1% N_2, impurity mainly O_2 with a trace of other gases found in air.

*Oxygen**. Tanks painted green contain 110 or 220 cu. ft. at 1800 lbs. pressure*. From Linde Air Products Co., 538 East 1st St., Boston, Mass. Purity 99.5% O_2 with traces of nitrogen and argon. "Dental size No. 3"* contain 20 gals. at 1000 lbs. pressure, from S. S. White Dental Supply Co., 120 Boylston St., Boston, Mass.

2. Strength of Stock Acids

Substance	Per cent. composition	Specific Gravity	Molecular weight	Molarity Calculated	Molarity by actual titration
Acetic (glacial)	99.5%	1.05	60.04	17.36	17.40
Hydrochloric	35 "	1.20	36.47	11.50	11.25
Lactic	85 "	1.21	90.06	11.25	9.4
Nitric	70.5"	1.42	63.02	15.82	15.80
Phosphoric	85 "	1.70	98.06	14.75	——
Sulfuric	96 "	1.84	98.08	18.01	17.95

3. Strength of Stock Alkalies

Substance	Per cent. composition	Specific Gravity	Molecular weight	Molarity Calculated	Molarity by actual titration
Ammonium hydroxide	28% (NH_3)	0.90	35.05	14.7	14.3
Potassium hydroxide (Saturated solution)	52%	1.54	56.11	14.2	14.7
Sodium hydroxide (Saturated solution)	46%	1.50	40.01	17.25	17.0

Table 11, SOLUBILITY OF COMPOUNDS most frequently used in this Laboratory.

Solubility is expressed in grams of Solute per 100 ml. of Solvent at 20° C.

Name of Substance	Formula	Water Crystalization	M. W.	Sol. H_2O	Remarks[9]
Acid,					
citric	$H_3C_6H_5O_7$	$.H_2O$	210.11	133	
oxalic	$(COOH)_2$	$.2H_2O$	126.06	10	
picric	$C_6H_2(OH)_2(NO_2)_3$		229.08	1	S: 6/A.
pyrogallic	$C_6H_3(OH)_3$		126.08	61.5	
tartaric	$C_2H_2(OH)_2(COOH)_2$		150.07	139	
trichloracetic	CCl_3COOH		163.40	1000	
boric	H_3BO_3		61.84	7	S: 4 x H.W.
Aluminum chloride	$AlCl_3$		133.34	69.87	
Alum					
amm. iron	$Fe_2(SO_4)_3(NH_4)_2SO_4$	$.24\ H_2O$	964.40	124	
potas. chrom.	$Cr_2(SO_4)_3K_2SO_4$	$.24\ H_2O$	1,006.51	20	
potas. alumin.	$Al_2(SO_4)_3K_2SO_4$	$.24\ H_2O$	948.77	5.2	
Amidol	diaminophenol HCl		197.01	20.5	
Ammonium					
acetate	$NH_4C_2H_3O_2$		77.06	148	
nitrate	NH_4NO_3		80.05	abt. 120	
chloride	NH_4Cl		53.50	38	
oxalate	$(NH_4)_2C_2O_4$		125.06	4	
sulfate	$(NH_4)_2SO_4$		132.14	75	

Barium					
chloride	$BaCl_2$	$.2\ H_2O$	244.32	39.7	S: 4 x H.W.
hydroxide	$Ba(OH)_2$	$.8\ H_2O$	315.51	5.6	S: 300 x H.W.
Calcium					
chloride	$CaCl_2$		110.98	74.5	S: 2 x H.W.
chloride	$CaCl_2$	$.6\ H_2O$	219.09	100	
Chromium					
oxide[10]	CrO_3		100.01	170	
Copper					
acetate (ic)	$Cu(C_2H_3O_2)_2$	$.H_2O$	199.63	7.2	
chloride (ic)	$CuCl_2$	$.2\ H_2O$	170.52	126	
sulfate (ic)	$CuSO_4$	$.5\ H_2O$	249.71	60	S: 2 x H.W.
chloride (ous)	Cu_2Cl_2		198.05	1.52	
Dextrose					
(glucose)	$C_6H_{12}O_6$	$.H_2O$	198.14	85	
Elon	monomethyl-p-aminophenol	SO_4	344.31	5.25	
Glycine	CH_2NH_2COOH		75.04	23	
Hydroquinone	$C_6H_4(OH)_2$		110.08	6.1	
Iron					
chloride (ic)	$FeCl_3$	$.6\ H_2O$	270.31	300	S: *inf.* x H.W.
sulfate (ous)	$FeSO_4$	$.7\ H_2O$	278.02	28	
Kodelon	p-aminophenol oxalate			1.25	
Lactose					
(milk sugar)	$C_{12}H_{22}O_{11}$	$.H_2O$	360.19	17	
Lead					
acetate	$Pb(C_2H_3O_2)_2$	$.3H_2O$	379.30	50	S: 4 x H.W.
chloride	$PbCl_2$		278.11	1.2	S: 2.5 x H.W.
Lithium					
chloride	$LiCl$		42.40	313	S: *inf.* x H.W.
Magnesium					
chloride	$MgCl_2$	$.6\ H_2O$	203.33	167	S: 2 x H.W.
sulfate	$MgSO_4$	$.7\ H_2O$	246.50	176	S: 4 x H.W.
Maltose					
(Malt sugar)	$C_{12}H_{22}O_{11}$	$.H_2O$	360.19	v. s.	
Manganese					
chloride	$MnCl_2$	$.4\ H_2O$	197.91	225	
Mercury					
chloride (ic)	$HgCl_2$		271.52	13.6	S: 4 x H.W. S: 33/100ml A.
Metol	(see elon)				
Osmium					
tetroxide[10]	OsO_4		254.80	6	S: in A.
Kodelon	(see elon.)				
Photol	(see elon.)				

Potassium					
bromide	KBr		119.01	63	
carbonate	K_2CO_3		138.19	93	
bicarbonate	$KHCO_3$		100.10	27	
chloride	KCl		74.55	32	
cyanide	KCN		65.10	abt. 50	
dichromate	$K_2Cr_2O_7$		294.21	24	
ferricyanide	$K_3Fe(CN)_6$		329.18	40	
ferrocyanide	$K_4Fe(CN)_6$	$.3\ H_2O$	422.32	30	S: 3 x H.W.
hydroxide	KOH		56.10	110	
iodide	KI		166.03	140	
nitrate	KNO_3		101.10	60	S: 4 x H.W.
oxalate	$K_2C_2O_4$	$.H_2O$	184.21	33	
permanganate	$KMnO_4$		158.03	10	
phosphate	KH_2PO_4		136.14	33	
sulfate	K_2SO_4		174.26	11.7	
thiocyanate	KCNS		97.17	185	
Quinhydrone	$C_6H_4O_2.C_6H_4(OH)_2$		218.08	s. s.	
Silver					
nitrate	$AgNO_3$		169.89	288	S: 3 x H.W.
Sodium					
Acetate	$NaC_2H_3O_2$	$.3\ H_2O$	136.06	v. s.	
borate, tetra or bi-	$Na_2B_4O_7$	$.10\ H_2O$	381.43	2.8	
carbonate	Na_2CO_3		105.99	14.8	
carbonate	Na_2CO_3	$.10\ H_2O$	286.15	100	
bicarbonate	$NaHCO_3$		84.01	9.9	
chloride	NaCl		58.46	36.5	
chromate	Na_2CrO_4	$.10\ H_2O$	342.16	abt. 120	S: *inf.* x H.W.
citrate	$Na_3C_6H_5O_7$	$.\ 2\ H_2O$	294.10	50	
cyanide	NaCN		49.01	50	
hydroxide	NaOH		40.01	103	
nitrate	$NaNO_3$		85.01	93	
oxalate	$Na_2C_2O_4$		134.01	3.7	
phosphate	Na_2HPO_4		142.05	14	
phosphate	Na_2HPO_4	$.12\ H_2O$	358.24	17	
K tartrate	$NaKC_4H_4O_6$	$.\ 4\ H_2O$	282.19	60	
sulfate	Na_2SO_4		142.06	14	
sulfate	Na_2SO_4	$.10\ H_2O$	322.22	35	
sulfite	Na_2SO_3		126.06	16.5	
bisulfite	$NaHSO_3$		104.07	25	
thiocyanate	NaCNS		81.07	v. s.	
thiosulfate	$Na_2S_2O_3$	$.5\ H_2O$	248.20	120	
Sucrose					
(saccharose)	$C_{12}H_{22}O_{11}$		342.18	200	
Thymol	$C_6H_3(CH_3)(OH)(C_6H_7)$		150.16	.09	
Urea	$CO(NH_2)_2$		60.05	100	

[9] s=solubility. A=alcohol. H.W.=hot water. *inf.*=infinitely soluble or in all proportions, 4 x H.W.=4 times more soluble in hot water,

[10] Forms the acid when added to water.

75; 1923, 28; 1924, 17; (including 3 females) (This is the last year when broods of young were observed and reported), 1927, Spring 13 birds (Including 2 females), Autumn 7 birds (All males); 1928, Spring 3 males, Autumn 2 males. December 8, 1 male. 1929, Lone male studied and photographed during April. Seen on the Green farm until May 11. Appeared again in October and was seen throughout the winter. 1930, Bird again observed and photographed during April and reported on the Green farm until the middle of May and again during the autumn and winter months. 1931, April 1, trapped and banded. Seen at Green farm until May 9. 1932, February 9. Seen regularly until March 11. April 6 reported as seen on the Green farm. July 18 reported two miles east of Green farm.

Proposed Introduction of Prairie Chickens

As in former years earnest requests have come from organizations as well as from individual sportsmen and bird lovers, to introduce the prairie chicken, a western sub-species to mate with the closely related heath hen, for practical or purely sentimental reasons. Interest in this experiment was revived on February 23, 1932 when Mr. W. F. Grimmer of the Wisconsin Conservation Department offered to furnish the live prairie chickens and to pay all expenses of transportation to Massachusetts. Mr. Loyd Taylor and other interested persons of New York generously offered to provide additional funds as might be needed to carry out the experiment. The Marthas Vineyard Rod and Gun Club voted to favor the introduction and the *Vineyard Gazette*, the local paper of the Island took a decisive stand for the project. In view of the local as well as national interest in the experiment the offers made by the State of Wisconsin and the New York gentlemen were again submitted to the Massachusetts Division of Fisheries and Game. After a thorough consideration of the matter the State Department of Conservation refused to issue a permit for the introduction of the birds. Mr. Raymond J. Kenney, Director of the Division of Fisheries and Game issued the following statement,—

> "The Commissioner of Conservation and the Director of the Division of Fisheries and Game have given very careful consideration to the matter of liberation of western prairie chickens on Martha's Vineyard. They consulted leading ornithologists and sportsmen in Massachusetts and obtained the sentiment of representative citizens of Marthas Vineyard and the majority opinion opposed the experiment. As this is purely a local matter in Massachusetts a final decision not to import prairie chickens was made on the basis of the foregoing."

In connection with the suggestion of the introduction of the prairie chickens the following statement was made in the heath hen report for 1931-32.

> "In the past many attempts were made to introduce the prairie chicken, the close relative of the heath hen, to Pennsylvania and the plains of New Jersey, Long Island, and Massachusetts, including Martha's Vineyard. Although these introductions were made in large numbers and with great care, every one of them resulted in failure. Likewise introductions of the heath hen, when these birds were abundant on Marthas Vineyard, made to Long Island and the mainland of Massachusetts, never proved a success. All attempts to rear the birds in captivity failed. It is apparent that Pinnated Grouse (heath hen and prairie chicken) do not lend themselves to such methods of conservation and are very sensitive to any change in their environment. They are not adaptable and are totally unlike the hardy pheasant, which can be readily transplanted from one part of the country to another. But grant that an introduction of prairie chickens to Martha's Vineyard would be successful, there would be only the remotest chance that the last heath hen would mate successfully with the prairie chickens. One reason of the failure of the heath hen to raise young since 1924, when there were still a number of females present with the males, was the fact that excessive interbreeding had brought about declining sexual vigor and sterility."

The atrophied sex organs of several males examined in 1925 gives strength to the view that our last heath hen is sterile. Furthermore ornithologists are not interested in a hybrid and the introduction of prairie chickens, a sub-species so similar in appearance to the heath hen would becloud and obscure the final chapter of the heath hen.

The wide spread publicity that has been given to the last bird of its race is in itself evidence of the interest that the public has maintained for the vanishing heath hen on Martha's Vineyard Island. In the complicated and perplexing problems of conservation with which so many persons are concerned there is destined to be diverse and discordant opinions and the case of the heath hen has not been an exception. The Massachusetts Department of Conservation fully realizes that it has in the heath hen a responsibility and a trust that is not limited to the state but which is national in scope. In dealing with this problem the Department has not followed its own inclinations but at present as in the past it has sought the advice of the leading sportsmen, ornithologists and conservationists and has closely adhered to what appeared to be the best policy for the majority concerned.

BOOK REVIEWS

The Invertebrata, by L. A. Borradaile, F. A. Potts, L. E. S. Eastham, and J. T. Saunders. 645 pp. $5.50. Cambridge: The University Press. 1932.

Teachers and students of invertebrate zoology have for some time been feeling the need for a textbook which would provide a more detailed and mature treatment of the subject than is found in the elementary textbooks generally used in our universities. In this new "Invertebrata," the authors have in a praiseworthy manner filled this long-felt need. The book is expressly intended for senior students, who are already familiar with the basic principles of invertebrate zoology, and therefore the authors have wisely refrained from giving a detailed account of the types generally dealt with in elementary textbooks. They have made a generous selection of examples, which are well chosen and carefully described. In their treatment they have kept an even keel, giving as much attention to the function and operation of the various organs as to their development and structure. Classification is sanely dealt with and ably used, the authors keeping within the limits of orthodoxy and yet giving life to the presentation of the characteristic pictures of the groups discussed. "The term 'Invertebrata' is retained to cover all the non-chordate phylo and the chordates other than the Vertebrata. In that sense it is used in this book. Only the Cephalochorda (amphioxus), which, though they are not vertebrates, have much in common with those animals, are left aside as best studied with them."

The authors are particularly to be commended for their treatment of the crustacea (chapter XII), a group which has not before been so adequately and clearly presented in so relatively brief a space, and which students have commonly found it difficult to thoroughly understand. Here matters of importance are discussed with competence, lucidity, and an understanding of the difficulties students often encounter in grasping the structural interrelationships of the members of this phylum.

The book is satisfactorily illustrated, containing 458 clear and accurate figures. The index has been carefully prepared and contributes to the usefulness of the book as a work of reference. The major part of the book has been written by the senior authors, L. A. Borradaile and F. A. Potts, both specialists of high standing in the field of invertebrate zoology. Chapters have been contributed by L. E. S. Eastham and J. T. Saunders, who have also shared in the preparation of the book as a whole.

"Invertebrata" should be eagerly welcomed by students specializing in this field, and should also appeal to those who for lack of inspiration have not heretofore been especially interested in this branch of zoology. —*Roderick Macdonald.*

THREE TEXT BOOKS OF ZOOLOGY

(1) *Zoology,* F. E. Chidester. 581 pp., 268 illustrations. $3.75. Van Nostrand. 1932.

(2) *Animal Biology,* L. L. Woodruff. 513 pp., 296 illustrations. $3.50. Macmillan. 1932.

(3) *Manual of Animal Biology,* G. A. Baitsell. 382 pp., 12 illustrations. $2.50. Macmillan. 1932.

These books represent three ways of presenting zoology to college students. The first is systematic and encyclopedic, the second treats of general principles of biology as applied to animals, and the third considers in more detail certain types of the animal kingdom. All three are well illustrated and provided with bibliographies and indices, and (1) and (2) have also a glossary.

(1) Chidester's "Zoology" contains a vast amount of information arranged in chapters each dealing with a phylum or a class of animals. There is an introductory chapter dealing with the general properties of living things and giving an outline of the classification, and the book closes with two chapters of a general character, one on the social life of animals and the other on evolution, heredity and eugenics. The chapters forming the greater part of the book are much alike in their treatment of the subject. For example, the one on the Amphibia begins with a very useful summary of the characteristics of the class. Then follow brief descriptions of orders and families with specific examples. The next eighteen pages are devoted to the anatomy and physiology of the leopard frog taken as a type of the Anura. The chapter closes with "General Consideration of the Amphibia," which includes distribution, anatomy, physiology, embryology, parental care, experimental embryology, habitat, fossil relatives, economic importance, and resistance to poisons—all treated briefly.

Two chapters are devoted to the Mammalia: one on the natural history, including Man both fossil and recent, and the other on physiology, including histology and anatomy. In a work of so wide a scope the treatment is often necessarily sketchy and it is not always easy reading. But the attention is held by numerous odd and unexpected bits of information, for example, the use of scallop shells as a badge by the Crusaders.

There are paragraphs one would like to rewrite and some inconsistencies, as the differences of the name of the Xth nerve in figs. 115 and 252. Haeckel's old plate, reproduced on p. 530, may be criticised as misleading in some respects. An unusual and very valuable feature of the book is the frequency of reference to original sources. If properly used, these will impress the student with the idea that zoology is a living subject and stimulate in him the spirit of research.

(2) In the "Animal Biology" of Woodruff the emphasis is on the physiological side. The book begins with four chapters on the scope of biology, cellular organization, protoplasm, and metabolism. Then follow six chapters on the natural history and anatomy of animals arranged in the larger groups. The next section, also divided into six chapters, gives an outline of vertebrate physiology. The remainder of the book, more than half its bulk, is devoted to general principles, including the origin of life, development, inheritance, adaptation, evolution, contributions of biology to human welfare, and finally a valuable chapter on the history of biology. An outstanding feature of the book is the excellence of the illustrations, largely the work of R. E. Harrison. The bibliography contains an extended list of treatises useful for collateral reading. The book may be especially recommended to students who are taking a single course in biology.

(3) Baitsell's "Manual" is a guide to an introductory course in zoology with laboratory instruction. It is intended to be read with (2), to which reference is made for figures; it can be used also with other textbooks, likewise referred to by pages, at the close of each chapter. The first chapter describes the structure and activities of animal and plant cells, and refers particularly to certain types of the latter. The following chapters contain descriptions of sixteen typical animals, including five protozoa, two coelenterates, and two insects, and the final chapter is a brief sketch of the development of the frog, chick, and mammal. The style is straightforward and clear. The book is remarkable for the absence of figures that students may substitute for laboratory work. Fig. 12 is a reproduction of the frontispiece from Harvey's "De Generatione Animalium" with the inscription "*Ex ovo omnia.*" The other illustrations, well adapted to excite interest, are from beautiful drawings by R. E. Harrison. Unfortunately in some cases the magnification is not clearly indicated. For figures showing details of structure there are frequent references to Woodruff. In all the chapters physiological activity is kept in mind in connection with structure. The chapter on the frog is the most extended, and is comparative with reference to other vertebrates and to man. It is prefaced by a systematic account of the classes of Chordata and the orders of Mammalia.

Part II of the manual consists in detailed directions, rather too helpful perhaps in places, for the laboratory study of the types described in Part I, including some mammalian structures.

The three books together form an interesting group. No one of them gives a complete picture of the animal kingdom. But if all three were read, with a judicious omission of overlapping parts, the entire animal kingdom when seen from the three points of view would emerge in a rather nice perspective. The reviewer feels, however, that these books, like many others of recent issue, attempt too much and too little. The field covered is too great for the beginning student to grasp, and the treatment is too brief for the adequate presentation needed by the advanced student. The "Manual" (3) is the least open to this objection. Yet perhaps a more intensive study of fewer types would be better adapted to awaken interest and illustrate the method of research in zoology. After all, for elementary students it is the method of science and interest in its pursuit, rather than content, that is important. —*R. P. B.*

A Textbook of Genetics by ARTHUR WARD LINDSEY. pp. xvi + 354. 128 figs. $2.75. The Macmillan Co. 1932.

This new textbook of genetics is a somewhat simplified exposition for college classes. It makes no excessive demands on the mentality, yet it is a well balanced account covering all of the more interesting and most of the important recent developments in the field. The sections on genetic data and principles form only about one half of the book, while the remainder deals with those applications which are usually most interesting to the general student.

The author indicates that he himself is chiefly interested in the bearings of genetic data on the problem of evolution, and this section is an excellent brief treatise. Certain other parts seem somewhat less fortunate, as for instance the chapter on biometry which seems to be included from custom rather than because it is definitely related to the genetic study of quantitative characters. The chapters dealing with human heredity offer no very critical discussion of this much discussed subject.

If a new book in this rather crowded field is justified, this will be found to be one of the best written and most usable of college texts. The questions and problems, and the well chosen references at the ends of the chapters, should be useful for teachers not actively interested in genetics, and for students who have no access to original data. —*H. H. Plough.*

Tropical Medicine. SIR LEONARD ROGERS, C.I.E., M.D., B.S., Physician and Lecturer, London School of Tropical Medicine, and J. W. D. Megaw, C.I.E., V.H.S., B.A., Major-General, Indian Medical Service. 536 pp. 77 illustrations, 2 in color. $4.00. P. Blakiston, Philadelphia, 1930.

These prominent authorities have produced a handbook which should be adequate for the physician who is confronted with any pathological condition likely to be encountered in the tropics. This work, however, is far more than a practical handbook. Each chapter contains sections devoted to the history, incidence, and prevalence of a disease, as well as to its diagnosis and treatment. This information is presented in a very readable manner, and there is much of general interest in the book.

Chemotherapy receives adequate recognition, but its limitations are quite properly stressed. Thus, quinine is contra-indicated in black-water fever, and arsphenamine would appear to be poorly tolerated by syphilitic lepers.

An interesting discussion of the colubrine and viperine types of snake-venom is given. The authors point out that a vast amount of research has yielded results of greater scientific than therapeutic value. It is impressive to note that 600 to 800 cc. of anti-venine intravenously would be required to neutralize a full dose of king cobra venom.

Typographical errors are few and unimportant. One which should be corrected in future editions is *Hydrocarpus,* which is used several times for *Hydnocarpus.* —*Thomas B. Grave.*

Colloid Chemistry, Theoretical and Applied. Volume IV. Second Series of Papers on Technical Applications. Edited by JEROME ALEXANDER. 734 pages. Price, $11.50. Chemical Catalogue Co., Inc., New York, 1932.

The appearance of this volume brings to a close the effort begun by Mr. Jerome Alexander some six years ago to collect a series of papers by international authorities on the various phases of colloid chemistry. The completion of this self-allotted task well testifies to the perseverence and boundless enthusiasm of the editor, and American chemists owe him a vote of gratitude for the collection and coördination of the vast amount of information presented in these volumes.

The present volume is entirely devoted to papers dealing with the application of colloid facts and theories to various phases of industry, running from those of cellulose, paper and wood to brewing, laundering, and synthetic mother-of-pearl. The wide range of topics considered precludes an adequate review by any one individual, particularly by one not well versed in the particular industries considered. At first glance one might conclude that this volume contains little of interest to the biological investigator. A more careful examination, however, discloses much of general interest. Thus the chapter on synthetic mother-of-pearl contains much of interest relative to the natural formation of this substance, and the chapters on dyeing contain suggestions which may be of interest to those seeking to improve present day methods of staining tissues.

It has long been recognized that in many respects the industrial applications of colloid chemistry have far outstripped the results of the laboratory investigators. This is quite evident throughout the text, and in many instances the reader is introduced to important findings which have not as yet found their way into the textbooks of colloid chemistry.

—*Kenneth Clark Blanchard.*

Agricultural Biochemistry. R. ADAMS DUTCHER and DENNIS E. HALEY. $4.50. John Wiley and Sons, New York, 1932.

The text opens with a concise history of the major developments of agricultural chemistry. The succeeding chapters are divided into three groups dealing respectively with general biochemical topics, the plant and the soil, and animal nutrition. The chapters of the first group follow rather closely the conventional treatment to be found in most textbooks of biochemistry.

These chapters constitute the weakest portion of the text. In many instances, important concepts are treated sketchily and often with an approach similar to that to be found in general science texts written for secondary schools. Perhaps this is necessary for classes of agricultural students—if so, it is unfortunate.

On the other hand the discussion of certain topics such as pH, buffers and colloids, is presented in such a fashion as to be useless to both the novice and the well-trained student. Further, this portion of the text suffers from a distinct lack of balance in the space devoted to various topics: for example, two and one half pages are devoted to phospholipins and three and one half to essential oils. In the chapter devoted to carbohydrates, the 2:4 oxide structure is assigned to normal fructose (page 46), and it is somewhat startling to find a statement that the carbohydrates as a class are amphoteric (page 36). The formula for furfural given on page 55 is wrong. The chapter devoted to the proteins is poor, as is chapter VI, entitled "The Physical State of Matter." The latter chapter of 15 pages, is a discussion of solutions, surface tension, osmosis, theories of membrane action, properties of fluids, buffers and colloids, served up as a sort of physico-chemical hash of little or no intellectual nourishment. Likewise, chapter VII, devoted to the enzymes, is rather unsatisfactory, as it contains no discussion of any importance relative to the kinetics or theory of enzyme action.

These shortcomings suggest to the reviewer that despite the extensive experience of the authors in agricultural chemistry they are rather poorly informed as to the nature and utility of many important biochemical facts.

In general this criticism is applicable throughout the book, although as soon as the authors enter upon the home territory—that is, the discussion of applied agricultural chemistry,—this sense of insecurity to a large extent disappears. The treatment accorded seeds, soils, fertilizers, insecticides, and the nutrition of plants and farm animals is for the most part sound. The professional biochemist will, however, question some statements included in the otherwise excellent discussion of some of these topics. Thus on page 375 we are informed that guanidine will combine with acetic acid to form guanido acetic acid, and on page 378 that 2 mols of urea and 1 mol of lactic acid may be caused to unite in the laboratory to form a purine. This evidences a lack of knowledge of the guiding principles of organic synthesis. On page 383 the authors subscribe to Martin Fischer's theory of muscle contraction, but pay no attention to present day knowledge of the chemistry of muscular activity. The discussion of fat synthesis, and the accompanying diagram on page 386 carry no information of value.

Chapter XXV is devoted to "Energy Metabolism," and contains a catalogue-like description of the apparatus used in the measurement of the gas exchange although no mention is made of the methods of calculation employed in indirect calorimetry and the conclusions which may be drawn from the results of such calculations. Apparently the authors are not acquainted with that fundamental and useful quantity, the heat of formation of a compound, for on page 399 they assure the reader that "When hydrocarbons are burned, the amount of heat is practically equivalent to that which would have been obtained if the carbon and hydrogen equivalents had been burned separately."

Certain topics which one would expect to find in a textbook of agricultural biochemistry are missing. For example, the reviewer has been unable to find any mention of the importance of cellulose fermentation in the nutrition of farm animals. A number of other criticisms might be made if it were not for the limitations of space imposed upon this review.

The text is profusely illustrated with photographs, charts and tables, although many of the first contribute nothing to the clarity of the discussion. —*Kenneth Clark Blanchard.*

Chemical Analysis by X-Rays and Its Applications: Georg von Hevesy, Professor of Physical Chemistry, University of Freiburg. Vol. 10 of the George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University. 333 pp. 101 figures. McGraw-Hill Book Company, New York. 1932.

In this book the author presents an exceedingly interesting exposition of the principal methods of X-ray analysis and many of the results which have been obtained by the use of X-rays. The book is divided into three parts, the first dealing with the technique of chemical analysis by X-rays. Beginning with an historical introduction, it continues to a description of apparatus required and then outlines analysis by means of primary omission and absorption spectra and by secondary radiation methods, giving numerous specific illustrations, and in particular, the complete analysis, both qualitative and quantitative, of thucolite. The relative merits of X-ray and optical methods are discussed. Here, within 119 pages, one obtains a concise introduction to the subject of X-ray spectroscopy as applied to chemical analysis. Many phases of X-ray spectroscopy which are of use to the chemist as well as the physicist such as crystal structure are beyond the scope of this book and as the author indicates in his preface, "Successful chemical analysis by means of Röntgen rays demands that the analyst possess some previous knowledge of X-ray spectroscopy." An appendix of 35 pages of tables of spectral lines under various useful classification follows.

Part II gives an authoritative and inspiring account of the discovery of hafnium. The chemistry of hafnium and its compounds is taken up. Zirconium, which is chemically similar to hafnium, necessarily receives considerable attention. This part of the book is an excellent illustration of the application of the scientific method showing the small place chance occupies in modern physical research and discovery.

In Part III, problems concerning the chemical composition of the earth and the solar system, and the abundance of the elements are dealt with. Various methods of attack are outlined including a study of igneous rocks, meteorites, the velocity of seismic waves, and the solar spectrum. Here, as in Part II, it is shown how X-ray methods often offer the most convenient and sometimes the only means of analysis, especially where elements of high atomic number are to be determined. A useful index of names and subjects is included.

Altogether it is a very readable book and should prove instructive to the layman as well as valuable to the man engaged in this special field of work. —*P. M. Roope.*

RESEARCH REPORTS OF INVESTIGATORS HOLDING SCHOLARSHIPS

Last Fall the five COLLECTING NET Scholarships of $100.00 each were awarded to the following students:

Name	*Course*
Mr. J. R. Jackson	Botany
Miss Helen M. Lundstrom	Physiology
Mr. C. M. Pomerat	Zoology
Mr. Thurlo B. Thomas	Zoology
Mr. George D. Young	Zoology

Mr. Young was unable to come to Woods Hole this summer Miss Lundstrom's report, which did not arrive in time to be included in this number, will be printed next year.

We print below a brief outline of the work accomplished by the three investigators who have carried out their work at the Marine Biological Laboratory during the present summer with the assistance of the grant from THE COLLECTING NET Scholarship Fund.

ISOELECTRIC RANGES OF GAMETES AND ZOOSPORES OF MARINE ALGAE

J. R. JACKSON

Graduate Assistant in Biology, University of Missouri.

An attempt is being made to differentiate between the male and female gametes of some of the marine algae by the use of a staining method developed by Naylor (*Am. Jour. Bot.* 13:265-275, 1926). Naylor stained sections of killed and fixed plant tissue with acid and basic dyes and washed them in buffers of known hydrogen ion concentration. He demonstrated that the nuclei of cells of such plants as corn and soy beans have an apparent isoelectric range alkaline to that of the cytoplasm of the same cells.

The author (*Science* 68: 89-90, 1928) applied the same method to the male gametes of one of the ferns (*Pteris longifolia*) and found that the cytoplasm of these cells had an isoelectric range comparable to that of the cytoplasm of the cells studied by Naylor. The nuclei, however, behaved as though they had an isoelectric range acid to that of their cytoplasm. These results indicated a possible interpretation of the function of the male gamete in fertilization which might be harmonized with the results of artificial activation of the eggs of some of the marine animals (F. R. Lillie, "Problems in Fertilization," University of Chicago Press, 1919).

Recent studies by the author (unpublished) have confirmed the acid isoelectric range of the male gamete nucleus and have demonstrated that the nuclei of the vegetative cells of the gametophyte of *Pteris longifolia* have an apparent isoelectric range alkaline to that of their cytoplasm. Nuclei of the female gametes have an apparent isoelectric range alkaline to that of their cytoplasm and slightly alkaline to the range for the nuclei of vegetative cells. Thus the nuclei of the male gametes of this plant have an isoelectric range more acid than that of any other gametophyte structure. It seems probable, therefore, that the apparent acidity of the male gamete is connected with its function in activating the female gamete to development.

These results suggest several questions. Does this difference between the isoelectric ranges of the nuclei of the gametes exist in plants other than ferns? If so, does it exist only in those plants which produce gametes which are morphologically unlike? Is there a similar difference between the nuclei of those gametes which are alike morphologically but unlike physiologically? Is there a comparable difference between gametes and zoospores and, if so, does the zoospore resemble the male gamete, the female, or neither in the isoelectric range of its nucleus? When, in the ontogenetic development of the plant, does this difference between gametes arise? Is this difference in apparent isoelectric range an evidence of a difference in metabolic activity between gametes of different sex or is it an evidence of some special material present only in the nucleus of the male gamete?

The investigation in progress was attempted with the hope of obtaining data which would suggest answers to the first four questions.

The following material has been collected and is being examined by the methods used by Naylor (1926) and Jackson (1928): receptacles, male and female gametes, stages in fertilization, and young sporelings of *Fucus vesiculosus*; gametes, stages in fertilization, zoospores, and gamete bearing tissue of *Ulva lactuca, Enteromorpha intestinalis,* and two species of Ectocarpus.

Considerable difficulty has been experienced in getting well fixed material and consistant staining reactions. Therefore it is not possible, at present, to give definite conclusions. Results indicate, however, that there is a difference between the isoelectric ranges of the nuclei of the male and female gametes of the anisogamous alga, Fucus. Such differences have not been satisfactorily demonstrated in Ulva, Enteromorpha, and Ectocarpus. However, conclusive evidence should be obtained for these species when the material already collected has been examined completely and critically.

This work has been made possible by a COLLECTING NET "Fellowship" for which the author wishes to express his most sincere appreciation.

A STUDY OF THE CYTOLOGY OF HEART AND SKELETAL MUSCLE

THURLO B. THOMAS

Department of Zoology, Oberlin College

As a recipient of one of the COLLECTING NET Scholarships for the summer of 1932 the writer was enabled to spend approximately two months at the Marine Biological Laboratory. The time thus far has been devoted to a comparative study of the cytology of heart and skeletal muscle from Limulus, the striated portion of the adductor of Pecten, and the retractor and radial muscles of Thyone. Several additional forms will be studied in the remaining time. The usual techniques for the demonstration of the chondriome and "Golgi apparatus" are being employed. It is hoped that through this preliminary study the writer will become familiar with the cytological picture presented in muscle tissues of various animals, as well as with the literature on the histogenesis of muscle. The work done this summer at the Laboratory will serve as an introduction to the problem of the cytoplasmic inclusions of developing muscle which it is hoped may be continued this fall under the direction of Dr. A. B. Dawson at Harvard University.

NOTE: We have also found it necessary to postpone printing the report by Mr. Pomerat until next year.

SCRIPPS INSTITUTION OF OCEANOGRAPHY

On Tuesday of this week Dr. and Mrs. L. C. Marshall of the Division of Radiation and Organisms of the Smithsonian Institution, Washington, D. C., arrived at the Institution for a stay of six or eight weeks. Dr. Marshall is aiding in the installation of new equipment at the Torrey Pines Field Station of the U. S. Department of Agriculture which is to be used in very accurate studies of the effect of light ("especially ultra violet and infra red") on growth of plants. He will make his headquarters at the Institution while this work is being done and make considerable use of its laboratory, in addition to having consultation with Professor Burt Richardson, who is doing Institution work of similar character.

Dr. F. M. Gilchrist of the Department of Zoology of Pomona College visited the Institution last week to make inquiry about places favorable for collecting young stages of development of one of the common jelly fishes. He was accompanied by two of his students. On Monday of this week they returned in order to use laboratory facilities of the Institution for several weeks while making special investigations of these animals.

Mr. R. S. Stewart of Ventura, California, visited the Institution last week to get information about ocean temperatures to use in connection with his studies on foraminifera.

Mr. Max Greenberg returned to the University of California at Berkeley last week after spending the summer on special researches in chemistry. He will go from Berkeley to the University of Texas Medical School where he holds an appointment as tutor in biochemistry.

Last week Director T. Wayland Vaughan received a letter from Rear Admiral G. H. Rock of the Bureau of Construction and Repair of the United States Navy in which there was a strong expression of appreciation of that Bureau of the importance of the work in the study of "fouling organisms" conducted at the Institution pier in cooperation with Prof. W. R. Coe of the Osborn Zoological Laboratory of Yale University. Admiral Rock especially stressed the value of investigations of this kind in relation to practical conditions of operation of naval and commercial vessels, saying that increase in knowledge of the habits of the organisms gives aid in devising measures for their partial control or avoidance.

A recent letter to Director T. Wayland Vaughan from Mr. George Steiger of the U. S. Geological Survey at Washington states that he will undertake to make spectrographic tests for the heavy metals (e. g. tin, copper, and zinc) in samples of marine bottom deposits recently sent to him by the Institution. He also states that he can easily make identifications of certain other substances at the same time. These determinations will give material aid in studies of bottom deposits now in progress at the Institution.

SCRIPPS INSTITUTION OF OCEANOGRAPHY

(Received August 22)

Last week Director T. Wayland Vaughan received a letter from Rear Admiral W. R. Gherardi of the Hydrographic Office of the U. S. Navy at Washington in which the institution was thanked for the offer of a loan of two reversing thermometers and a supply of water sample bottles. The letter states that the offer is being accepted and that the instruments will be used (probably) by the surveying vessels *Hannibal* and *Nokomis* in operations toward or about the region of Panama. With these thermometers temperatures will be taken at a number of depths mostly between the surface and 1200 meters. Director Vaughan was requested to suggest stations to be investigated.

On Friday of last week Miss Frances Charlton left the Institution after spending three months in special study of foraminifera.

KARL BELAR

KARL BELAR

Dr. Karl Belar, who carried on work in the Marine Biological Laboratory during the summer of 1929, died as the result of an automobile accident on the 24th of May, 1931. He came to America on the invitation of the California Institute of Technology as visiting professor for one year, which was extended to a second year. He had expected to return to Germany during the summer of 1931, by way of the Orient.

Dr. Belar was born in 1895, and at a very early age showed exceptional interest in microscopic technique. He began his serious work, partly in a private laboratory, and partly at the University of Vienna. His studies were interrupted by the world war, from which he returned in 1918, and in the following year he received his doctor's degree. He acted at that time as assistant to Professor Hartmann of the Kaiser Wilhelm-Institut in Berlin-Dahlem, and at the same time became Privat-dozent at the University of Berlin. He began work on the nuclear and cell division of the Protozoa, which he carried out for several years. The results appeared in a series of important papers. In 1926 he published a book on the changes in form of the nucleus of the Protozoa, which contained a review of the extensive literature up to that time. Following this early work on the Protozoa he undertook an extensive study of the mechanism of cell-division, both in plants and animals. He brought forward a working hypothesis concerning the rôle of the spindle fibres in relation to the movement of chromosomes based on some ingenious experimental methods on living materials. He continued work of a related kind during the two years he was in Pasadena, especially on eggs of the marine worm, Urechis. He had accumulated a large amount of material, but had not put his results in final form when the unfortunate automobile accident ended his career. The material and notes have been sent to Germany, where, with the assistance of Mrs. Karl Belar, it is hoped some of his results may be recovered.

Belar had developed a remarkable technique as a result of his wide experience. He impressed all who came in contact with him not only as an exceptionally fine technician, but also as an acute observer. He had, in addition, a very unusual talent for drawing, and the figures that illustrate his papers and books bear testimony to his skill in representing microscopical preparations, as well as the artistic feeling with which they were presented. Belar was, however, much more than a successful manipulator and acute observer. He was extremely critical, not only with regard to his own work, but also of the work of other observers, as illustrated by the admirable reviews which he published from time to time, both as summaries of a larger field, and as reviews of individual papers and books. This is especially illustrated by his last article on "Befruchtung," in The *Handwörterbuch der Naturwissenschaften.*

His early death was a great loss to science, and a personal loss to a wide circle of friends.

—*T. H. M.*

A WOODS HOLE RECORD OF THE TROPICAL FISH, PSEUDOPRICANTHUS ALTUS[1]

EDWARD L. CHAMBERS and BRADFORD CHAMBERS
Woods Hole, Mass.

This beautiful little fish of burnished gold is only a little longer than it is deep. It is shaped somewhat like a freshwater sunfish, but it is more heavily built. The specimen shown in the photograph is very young, less than one and one-half inches long; but in its normal habitat an adult grows to a length of eleven or twelve inches.

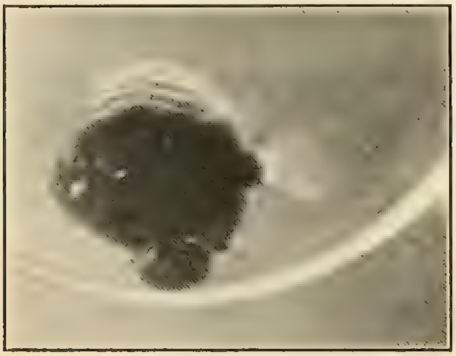
The fish is tropical, living off the coast of Brazil, and extending as far north as South Carolina. However, young specimens are sometimes carried long distances by the gulf stream. This specimen probably got into the stream in its larval stage, and grew as it was carried northward along with Sargassum weed and jelly fishes. Finally a favorable wind wafted it to the shores of Buzzards Bay on our bathing beach.

In the summer of 1899 several specimens were caught here, and exhibited in the U. S. Fisheries. At that time Mr. C. R. Knight made a water color painting of one which he has kept in his private collection.

It is a rare fish, even in its native haunt, and in scientific literature its vivid coloration has never been adequately described. Descriptions have been made from preserved specimens in which the coloring, especially of the brilliant spots, is gone.

The general color of the body is dusty red, due to an uneven distribution of both red and black microscopic pigment spots. The head is heavy and thick with a snobbishly upturned mouth. The eyes are very large and shiny black, surrounded by a thick margin of orange. Extending down the sides of the body are three streaks of pale

[1] A rare fish was discovered Tuesday by one of our youngest Woods Hole Investigators, Bradford Chambers, son of Dr. Robert Chambers. On emptying the water out of his boat on the Buzzards Bay beach, he was attracted by a brilliant red body bobbing about in the boat.



THE TROPICAL FISH

This picture shows the brilliancy of the eye, the black ventral fin and the long dorsal fin with the three rows of vivid red spots. The red body and the red spots show black in the photograph.

pink, deepening to red lower down, so as to disappear into the general red color of the body. These streaks resemble rays of sunlight.

The dorsal fin is long, extending from a little behind the head almost to the tail, its outer edge appearing serrated. When closed the fin lies in a groove. The fish when excited opens it up and thus produces a brilliant effect, because of the fin's extraordinary coloration. The tips of the fin are bright yellow. Below are three rows of brilliant orange discs like peacock eyes outlined by black circles against a white background. Along the base of the fin is a row of similar discs but broken. The posterior or soft part of the dorsal fin is almost wholly transparent with a number of very small scattered black spots.

The tail is pearly white at its base, the remainder being scattered with very small black spots, similar to those on the soft part of the dorsal and anal fins.

The pectoral fins are completely transparent, except for a few black spots.

The pelvic or ventral fins are relatively large and have dusky markings, like the orange discs of the dorsal fin.

The spiny part of the anal fin is covered with the characteristic orange spots. However, the whole fin is dusked and the edge is darkened by a thin line of black pigment. The posterior or soft part of the anal fin completely resembles that portion of the dorsal fin in being colorless.

We take this opportunity of expressing our appreciation to Dr. Schroeder of the Oceanographic Institution, who identified the fish and has helped us in describing it.

LOW TIDE AT BAY SHORE BEACH

showing the path which Dr. Linton has kept open for so many summers. We hoped also to be able to print a later photograph of the team of horses dumping sand from Dr. Glaser's beach over the stones above high tide mark on "Lot X". However, the time was too short to have the half-tone plate made.

GENERAL SCIENTIFIC MEETING

Friday, September 2, 1932.

MORNING

Mr. C. M. Goss, Mr. Bruce Hogg and Dr. Kenneth S. Cole, "Tissue Culture Action Potentials."

Dr. Ethel B. Harvey, "Effects of Centrifugal Force on Fertilized Arbacia Eggs, as Observed with the Microscope Centrifuge."

Dr. P. S. Henshaw, "The Comparative Radiosensitivity of Marine Invertebrate Eggs."

Dr. Margaret Sumwalt. "Anomalous Potential Differences across Frog Skin."

Dr. Walter S. Root, "The Carbon Dioxide Dissociation Curve of Frog's Skeletal Muscle."

Mr. S. A. Corson, "The Effect of Acid and Alkali on the Plasmogel of Amoeba proteus."

Dr. F. J. Brinley, "The Action of Salts on Fundulus Embryos."

Intermission

Dr. Oscar W. Richards, "The Estimation of the Growth of Yeast Populations with a Photo-electric Cell."

Dr. George A. Baitsell, "A Simplified Technique for the Cultivation of Tissues in Vitro."

Dr. T. M. Sonneborn, "Some Genetic Consequences of Self-Fertilization and Cross-Fertilization in Paramecium aurelia."

Dr. E. R. Clark, Mrs. E. L. Clark and Dr. E. A. Swenson, "Motion Pictures Showing the Contraction of Arterioles in the Rabbit's Ear."

Dr. C. C. Speidel, "Moving Pictures of the 'Fast Motion' Type of Various Cells in Living Frog Tadpoles."

AFTERNOON

Mr. L. V. Beck, "The Effects of Penetrating and Non-Penetrating Acids and Bases on the Oxidation-Reduction Potential of Asterias Ova and of Asterias Sperm."

Dr. G. H. A. Clowes, Miss Anna K. Keltch and Miss Ilene Harryman, "On Inhibition of Maturation of Starfish Eggs by Acids and Acid Producing Agents and the Reversal of this Process by Alkalies."

Miss Anna K. Keltch, Miss Lucille Wade and Dr. G. H. A. Clowes, "On the Contrasting Sensitivity of Eggs and Sperm to Various Chemical Agents."

Miss Ilene Harryman, Miss Lucille Wade, Miss Anna K. Keltch and Dr. G. H. A. Clowes, "On the Action of Soaps of the Oleate and Ricinoleate Series on Arbacia Sperm."

Dr. R. Chambers, "On the Formation of the Segmentation Furrow in the Sea Urchin Egg."

Dr. C. G. Pandit, "pH of the Arbacia Egg". (Presented by Dr. R. Chambers)

Dr. Dorothy R. Stewart and Dr. M. H. Jacobs, "The Influence of Temperature on the Permeability of the Arbacia Egg to Ethylene Glycol." (Presented by Dr. Dorothy R. Stewart)

Dr. Dorothy R. Stewart and Dr. M. H. Jacobs, "The Permeability of the Egg of Asterias to Water." (Presented by Dr. M. H. Jacobs.)

Mr. Otto Meier,, Jr., "The Use and Cost of Electrical Energy in Relation to Investigators in Attendance at the Marine Biological Laboratory."

LIBINIA, THE SPIDER CRAB

Libinia, Libinia, the Spider Crab,
Sat among the rocks of the bathing beach
And watched the toes of men go by.
"They are a queer looking lot,"
She cannily thot.
And who would have thunk she thot.

Libinia, Libinia, the Spider Crab,
Reflected, McInnis, McNaught,
And the rest of the lot ought to be taught
I ought not be caught
So, she spitefully thot.
And who would have thunk she thot.

Libinia, Libinia, the Spider Crab,
Scientifically watched among the frothing rocks
"Fives, always fives, this must be stopped"
She drastically thot
And experimentally tried her cheliped
And who would have thunk she thot.

McInnis with sarcastic remark,
And epithet gay, limped away,
But they say to this day
He lets Libinia stay
Among the frothing rocks—
And who would have thunk she thot.

—*Embryology Student,* '31.

THE PACIFIC BIOLOGICAL STATION

Among the summer Investigators at the Pacific Biological Station, Nanaimo, B. C., Canada, are:—

Professor R. A. Wardle, Department of Zoology, University of Manitoba: Cestode parasites of Pacific coast fish. Mrs. Ella Kuitenen, graduate student, is associated with him in the investigation.

Dr. F. D. White, Department of Biochemistry, University of Manitoba: Chemical analyses of certain fish of commercial value.

Dr. W. Freudenberg, Department of Chemistry, Iowa State College: Investigation of glycogen of oysters and clams.

Dr. W. A. Riddell, Department of Chemistry, Regina College: Method of determination of nitrate values in seawater.

Dr. D. C. B. Duff, Department of Bacteriology, University of British Columbia: Certain epidemic diseases of trout and young salmon.

Mr. G. H. Wailes, Vancouver: Marine Protozoa.

Mr. D. C. G. MacKay, graduate student, Department of Zoology, Stanford University: The life history of the commercial crab.

Mr. S. H. McFarlane, graduate student, Department of Zoology, University of Illinois: Trematode parasites of Pacific coast fish.

Mr. G. V. Wilby, graduate student, Department of Biology, University of Toronto: The life history of the ling cod.

Dr. Beall, Department of Chemistry, University of British Columbia: Chemical analysis of the waste effluent of pilchard reduction plants.

Mr. E. C. Black, University of British Columbia: Breeding periods of the pile borer, Bankia, on the coast of British Columbia.

The Collecting Net

An unofficial publication devoted to the scientific work at Woods Hole.

WOODS HOLE, MASS.

Ware Cattell .... Editor

Assistant Editors

Annaleida S. Cattell   Vera Warbasse

Contributing Editor to Woods Hole Log
T. C. Wyman

The Collecting Net Scolarships

The staff of the course in physiology has awarded its Collecting Net scholarship of $100.00 for the summer of 1933 to Mr. Iping Chao who is a graduate student in the Department of Physiology at the University of Chicago. Next summer Mr. Iping will continue his work on the effect of electrolytes on the Limulus heart. Mr. Herbert L. Eastlick—a graduate student in the Department of Zoology at Washington University—was awarded a similar scholarship by the staff of the course in embryology. Mr. Eastlick will make a cytological study of striated and smooth muscle fibers in *Pectin gibbus*. The other three courses have not yet awarded the scholarships which go to their students.

We wish to acknowledge the many gifts that we have received which have made it possible for us to accumulate the sum of a little over $600.00. Especially do we wish to extend our thanks to the Penzance Players who contributed $76.00—a sum made up from the proceeds of their 1931 play, "The Queen's Husband." We are grateful, too, to Dr. Ralph Cole, proprietor of the variety store in Falmouth, who every year contributes $10.00 to Dr. and Mrs. Alfred Meyer who for two years in succession have given $25.00, to Dr. James A. Dawson for his gift of $15.00, and to many others for their smaller contributions.

The Penzance Players have produced plays for five years, last year the play being Sherwood's "The Queen's Husband." Those taking part in it were:

King Eric VIII........................Alfred Compton, Jr.
Princess Anne (his daughter)......Vera Warbasse
Frederick Granton (secretary) Frederick Copeland
Queen Martha .... Margaret Kidder
General Northrup .... Tom Ratcliffe
Lord Birten (advisor) .... Comstock Glaser
Prince William of Greck
(Anne's suitor) .... Wister Meigs
Phipps (butler) .... Arthur Meigs
Major Blent .... William Woglum
Soldier .... John Frost
Dr. Fellman (communist) ...... Preston Copeland
Laker (communist) .... George Clowes

Miss Sheila Balfour directed the group with the aid of Alfred D. Compton, Jr.

Phosphorescent Screens

Earlier in the season a man representing a firm in Holland visited the laboratory for several days in order to sell certain phosphorescent screens which enable one to make a reproduction of a page from a manuscript or book without the use of a camera. He exhibited orders from many biologists of standing, and through "a winning personality" and "high-power salesmanship" finally persuaded the Marine Biological Laboratory to purchase a set of screens on condition that they could be submitted to thorough tests before payment for them was made.

In describing the process of reproducing pages from a publication without a lens, *Nature* writes in a recent number. "The paper is then exposed for a short time to the light from any convenient ordinary source of white light of low power". Concerning the patented screens for this purpose they remark "However, while these phosphorescent screens are sometimes convenient, they are costly and unnecessary."

Editorial Notes

The Reynold A. Spaeth Memorial Lecture on "Genetics and Development" by Dr. Richard Goldschmidt will be printed in an early number of the *Biological Bulletin* Its publication in this number of The Collecting Net is made possible through the courtesy of the *Bulletin*, and we wish to express our appreciation for this privilege which has been extended to us.

The Falmouth Enterprise is to be congratulated for presenting so fairly in its recent numbers the news and statements concerning the beach question. The way in which they are handling the situation is appreciated by people on both sides of the fence.

We wish to express our thanks to Mrs. Ruth E. Thompson, owner of the Quality Shop, who has allowed us to use her telephone during the summer.

The Collecting Net has a great many good books for sale in its office on Main Street. The prices for them have been reduced by thirty to sixty per cent.

ITEMS OF INTEREST

THE BEACH QUESTION

The fact that the people of Woods Hole appreciate a sandy beach is evident by their distribution on the Bay Shore Beach. Formerly they huddled on Dr. Strong's beach against the fence—now they are scattered more or less evenly over the improved portion of "Lot X". One of the lot-holders stated in the *Falmouth Enterprise* that "the number of people using the beach scarcely reaches fifty at even the most popular hours." They gave that as a reason why no more beach area was needed. Did it occur to that writer that the reason so few people bathed there was because there was so little sand! One day last week there were 126 individuals at one time on the sand on "Lot X" and Dr. Strong's lot.

Everybody is grateful for the improvements which are now being made on the Bay Shore beach by the lot-holders. They have given most of the money for the work and Dr. and Mrs. Glaser have contributed sand from their own beach. There is ample room just now to care for all those who wish to use the beach.

Valuable as these improvements are, they must not be allowed to obscure the fact that more fundamental changes must be made. It is not unlikely that winter storms will carry away much of the sand which is not actually held in place by stones. In our opinion the money which was collected should have been saved so as to make the improvements next June when we would have had full benefit from them. The work is not yet completed and the season is so nearly over that many people have left for their winter homes.

The work is not yet completed and the season is so nearly over that many people have left for their winter homes.

Perhaps money could be collected every Spring to improve the beach in the manner that it is now being done, but we are not sure that this plan would be entirely satisfactory. Children of all ages, and adults as well, will flock to the sandy beach. If the sand is above high tide mark it will not be cleansed twice a day by incoming tides, like that of the beach in front of the lots to the northwest. Is it not possible that the sand will finally accumulate so much dirt and debris, thereby becoming more or less unsafe from the standpoint of public health? There have been cases of whooping cough and measles in Woods Hole this summer. Last week children with contagious skin diseases — tinea trichophytina, (ring worm) and impetigo (barber's itch) were observed playing in the sand.

A permanent and satisfactory solution must be found. We still feel that it would be a gracious gesture for the lot-holders to take down the fence. If they do not choose to do so, we hope that the town of Falmouth will assume control of the beach in front of their sea wall. Suitable restrictions could easily be made—even to the extent of allowing only the residents of Woods Hole and their guests to use it.

The price of the book by Dr. Parker on "Humoral Agents in Nervous Activity with Special Reference to Chromatophores," which was reviewed by Professor Bard in the July 9 issue of The Collecting Net, is $1.75. The book is distributed for the Cambridge University Press by the Macmillan Company in this country.

CORRECTIONS

In the article on "*Eulima oleacea* and Thyone published in the last number of The Collecting Net the statement was made that the eyes of Eulima do not show in its retracted state. I have since found that they show as little black dots, but in thickened or eroded shells they may not be seen. —*G. M. Gray.*

The motion made to me, but not seconded, was not as reported in The Collecting Net of August 13, p. 212, "that the Town of Falmouth take over this beach". The motion was to substitute for the four plans presented by the Committee the one that I had outlined. This was to petition the Town for police protection of the beach in return for the removal of certain restrictions. It seems to me unnecessary to deprive anyone of his property rights. —*R. P. Bigelow.*

BOOKS AT THE M. M. L. CLUB

A lending library has been established at the M. B. L. Club and a few of the latest books have been purchased and others donated. These are now available to club members. The charge for each book is ten cents for three days and twenty-five cents for one week. Some of the books available now are: Dimmet, "What We Live By"; Zweig, "Letters from an Unknown Woman"; Brown and Jeffcott, "Beware of Imitations"; Willa Gather, "Obscure Destinies"; Walling, "Murder at Midnight"; Buck, "Good Earth"; Nash, "Nothing but Wodehouse"; Morgan, "The Fountain"; Webster and Hopkins, "Tell Your Own Fortune"; Massoer, "Within"; Stuart, "Pigeon Irish"; "Andree's Story—A Complete Record"; Huxley, "A Brave New World"; Guenther, "A Naturalist in Brazil"; McSpadden, "To the Ends of the World"; Wassou, "Columbus Came Late". These books are available on the mantel piece at the M. B. L. clubhouse. More books are being acquired. —*V. W.*

WOODS HOLE LOG

THE ANNUAL MEETING OF THE WOODS HOLE PROTECTIVE ASSOCIATION

The annual meeting of the Woods Hole Protective Association was held in the Old Lecture Hall at eight o'clock, August 11. After the reports of the secretary and treasurer by Miss Tinkham, the nominating committee, consisting of Dr. P. H. Mitchell, chairman, Miss Compton, and Mr. Charles Taft, was asked for its recommendations. Dr. Mitchell reported that the committee proposed for re-election for 1932-1933 those persons holding office during the past year, namely, Dr. Baitsell, chairman, Mr. Addison, vice-chairman, Miss Tinkham, secretary-treasurer, Dr. Edwards and Mr. Sam Cahoon, members at large, all of whom, with the exception of Miss Tinkham, have held office for only one year. It was voted unanimously to accept the committee's recommendation.

One of the chief projects of the Association is the maintenance of an inspector to take care of the property of association members during the winter. Miss Tinkham reported that the inspector's work has been unusually light this last year; there was much less damage done by storms and very few houses entered. A detailed report is given to Miss Tinkham covering the work done by the inspector who visits each property once a week, or more often in case of bad storms.

The Association has also undertaken the responsibility of spraying the trees in Gansett Woods in an effort to get rid of the gypsy moth. This moth has increased a great deal during the last year all over the Cape—it is said to be the worst in twenty years. Due to the early spraying, however, the oak trees in the Gansett Woods have done remarkably well this year.

The Woods Hole Yacht Club is turning into a thriving club when one realizes that it had been forgotten for almost fifteen years. In 1930 the young people of Woods Hole wanted to have a Yacht Club and started to organize one. They found that in 1897 such a club had been founded but in the course of time had died out, and that the laboratory had bought the yacht's club house and turned it into the M. B. L. Club. The old yacht club was brought up to date and a few races were held at the end of that summer. Last year the club had really become a firmly established organization. This year not only does the yacht club hold races for different classes, unite with other yacht clubs to hold joint races, but also has festivities here in Woods Hole.

THE BAY SHORE BEACH IMPROVEMENTS

A hundred and eighty-eight loads of sand have been hauled by team from the beach in front of Dr. Otto Glaser's lot and dumped on top of the stones above high tide mark on "Lot X" beach. This work has been made possible by contributions from Dr. Strong, Dr. Meigs, Dr. Glaser, a $25.00 gift from a member of the laboratory who prefers that his name be unknown, and a couple of smaller contributions. It is understood that this improvement of the "public" beach was brought about through the initiative of Dr. Strong. The group is planning to have most of the smaller stones between the high and low tide marks removed and to use them to build a wall well back from the water to prevent the earth on Dr. Strong's lot from becoming mixed with the sand immediately in front of it.

THE PENZANCE FORUM

Mr. Frederick Howe, sociologist, spoke last Sunday at the Penzance Forum on "Our Changing World." He gave some illuminating views on our depression, the current political situation, and the future. He said that we should turn our hands to form a new standard of living, of amusement and of business. Mr. Howe prophesized that there would be vast armies of men this winter seeking relief. Congress is the only possible Santa Claus and it can not borrow more. Nor can it raise taxes because people have not money to pay them. There may be a universal movement against taxes for already a million farms have been sold because of their non-payment, and for default of interest. Mr. Howe is not as cynical as it might appear—he has merely become wise from observing the affairs of the world. —*V. W.*

Last Tuesday Mr. J. A. Sither, who is working for the Supply Department, left Woods Hole in a sailing dory for Cuttyhunk to collect some rare tunicates. Off Juniper Point he was carried towards the reef and as he attempted to avoid the rocks the boat jibbed and capsized, the ballast causing it to sink immediately. Fortunately a fishing boat picked him up, but not until the tide had carried him beyond Nobska. He was taken to the fish market in an exhausted condition where he quickly recovered. —*V. W.*

Miss Edwina Morgulis was awarded the Ann Radcliffe Fellowship by Radcliffe College, and will spend the coming year in study at the Sorbonne in Paris. Mrs. Morgulis is going to accompany her daughter to Paris and plans to remain there with her during the year.