L. A. O'Donnell S.J.

S.J.B.

A. M. D. G.

BULLETIN

of the

American Association of Jesuit Scientists

(Eastern Section)

For Private Circulation

LOYOLA COLLEGE

BALTIMORE, MARYLAND

VOL. IX MARCH 1932 NO. 3

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Bulletin of American Association of Jesuit Scientists

EASTERN STATES DIVISION

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EDITORIAL

The scientific achievements of the past year give evidence to the truth of the statement: the march of science. Science did progress during the past twelve months and the world of science knows more today than it did a year ago. From the macroscopic to the ultra-microscopic, from the largest to the smallest material, from the limits of the universe to the cores of atoms,—science learned new facts and advanced a few steps along the path of knowledge.

Continuing and amplifying the work started last year, physicists sought to develop further methods of attaining tremendous voltages for use in super X-ray tubes. Professors Basche and Lange in Switzerland sought to tame the high voltage present in lightning by stringing long wires across peaks in the Alps. These wires which served as antenna to draw the electrical energy present in thunderstorms to a new form of X-ray tube, which they invented. This tube was made of paper, rubber and aluminum and withstood the strain of 2,600,000 volts.

Another method of generating high voltage was recently exhibited by Dr. Robert Van de Graaff of Massachusetts Institute of Technology, based on electro-static principles. This revival of technique known for over fifty years promises to produce from 20,000,000 to 50,000,000 volts with inexpensive apparatus. Work is now in progress to attain these potentials.

Still another means of obtaining high voltage is the method of Professor E. O. Lawrence, of the University of California, who with Edlefsen, Livingston and Sloan, has used what is popularly called the "slingshot" phenomena. These investigators have secured light positive ions and heavy mercury ions with energies greater than one million volts and are now starting experiments by which they hope to produce high speed electrons in the same way. In this research ions are made to describe spiral and very nearly circular paths between the poles of two magnets and at each revolution receive a boost of some ten thousand volts. This small voltage, supplied at exactly the right time, soon builds up the energy.

Science has a very good use for this energy. The science of physics and chemistry would like to learn more of the secrets of the atoms when they are bombarded by particles with great amounts of energy; and these latest experiments on high voltage hope to supply the energy.

In the Bureau of Standards laboratory in Washington the division of low temperature measurement succeeded in liquefying, for the first time in this country, the gas helium. This work, performed by Dr. Dickinson and Dr. Brickwedde, marks a forward advance in this field in this country. Dr. Brickwedde was also instrumental in research leading to the discovery of a new form of hydrogen, an isotope, at Columbia University by Professor Urey and Dr. Murphy. This isotope is the simplest form ever discovered and should provide theoretical scientists with a stepping stone on which to pause in the jump in their theories on the structure of hydrogen to the next higher element, helium. Dr. Brickwedde concentrated the new isotope from ordinary hydrogen in such amounts that a spectroscopic analysis could be undertaken.

Going from the theories on small particles to those of large bodies, astronomy continued its studies of the limits of our universe. Mount Wilson Observatory, with its champion reflector of 100 inches, led this work and found a new record for the motion of distant nebulae away from the earth. One was discovered whose velocity was 10,000 miles a second. After two years work, the largest all-American made telescope, built for the Perkins Observatory of Ohio Wesleyan University, was completed and is now ready for installation. The casting of the sixty-nine inch mirror was completed at the Bureau of Standards and the mirror ground at works of J. W. Fecker in Pittsburgh to an accuracy of one-millionth of an inch.

Twenty years of research by Dr. C. G. Abbot in Washington on the relation of weather and solar radiation led to a culculating device which is useful in making long-range weather predictions.

In biology and medicine a new powerful tool was completed with the work of Dr. Royal R. Rife, of San Diego, who perfected a microscope capable of a magnification of 17,000 diameters. This apparatus is es-

Continued on page 123

Dedication

With Humble Recognition

of His Untiring Devotion

to the Cause of Science

This Number of the Bulletin

is Dedicated

to the Memory of

Rev. George L. Coyle, S.J.

Professor of Chemistry

Rev. George L. Coyle, S.J.

REV. GEORGE L. COYLE, S. J.

"Doctrina sed vim promovet insitam,
Rectique cultus pectora roborant."

—Horace, Bk. IV, Od. IV, 1, 33.

The man who plods along the journey of life doing a goodly amount of work daily, who can look back at the end of the day and realize he labored for a noble purpose, who can continue this routine for forty years and more,—such a man is a successful member of any organization. Many men of this type go through life with little notice, but when they are suddenly summoned by the Master to receive their reward, their finer qualities are realized and their worth recognized.—Such a man was Father George Coyle, Head of the Chemistry Department of Georgetown University.

Father Coyle was born in Philadelphia, Pa., December 11, 1869. His early education was at St. Malachy's Parochial School and LaSalle College in his native city. Even as a boy he displayed two splendid qualities, piety and generosity. When he was eighteen years old he entered the Society of Jesus at Frederick, Maryland; and on December 31, 1889 he pronounced his first vows. After one year of classical studies he taught at Holy Cross College, Worcester, Massachusetts, for one year. From Holy Cross College he went to Woodstock College, Maryland to study philosophy and science from 1891 to 1894. While at Woodstock he devoted much of his time to the study of chemistry, which he made the principal avocation of his life. After finishing his studies at Woodstock College, he was assigned to teach chemistry at Gonzaga College, Washington, D. C. Here he remained from 1894 to 1898 and made many improvements in the chemistry department, due to his zeal for progress and high standards of education.

Having finished his five years of regency, he was anxious to begin his theological studies at Woodstock College. However, his regular course was interrupted, since he was asked to teach chemistry to the scholastics. For two years he was Professor of chemistry and at the same time studied moral theology. During his third year at Woodstock he gave all his time to the study of dogmatic theology and was ordained to the priesthood in June, 1901 by His Eminence, James Cardinal Gibbons. In September of that year, he was again requested to teach chemistry for another year to the scholastics; the following two years he devoted all of his energies to dogmatic theology. After having completed his entire course in theology, he was assigned to teach chemistry and mathematics at Woodstock College. In all, he spent seven years at the Collegium Maximum, namely from August 1898 to June 1905.

The following year he spent at St. Andrew-on-Hudson, Poughkeepsie, New York, to make his third year of probation.—As professor of chemistry he showed such exceptional ability for that science that he was permitted a year of research in organic chemistry at the University of Göttingen, Germany.

In September 1907, he was appointed Professor of chemistry at Holy Cross College, Worcester, Massachusetts, where he remained as Head of the Department for sixteen years. His energy was untiring and the improvements that he made were remarkable. It was during this time he published his three books on Basic Analysis, Acid Analysis and Dry Analysis. During this period, he was made a Director of the Northeastern Section of the American Chemical Society.

From Holy Cross College, in September 1923, Father Coyle was sent to take charge of the Chemistry Department at Georgetown University, Washington, D. C. Here he came in close contact with the executive council of the American Chemical Society; and he conceived the idea of a great Research Institute for Medico-Chemical investigations to be built on the University campus. He labored unceasingly to arouse the interests of the professional and commercial world to contribute to this noble cause. The results of his efforts for the first two years looked very promising and great progress was made due to his zeal and enthusiasm. However, financial circumstances in the world of business put a halt to his progress. Although the building was not erected, he collected sufficient funds to begin his noble plan; so he engaged several laboratories in the new Georgetown Medical School, where a staff of research workers are maintained and working on the problems of cancer and nephritis.

During the world-war Father Coyle was one of the members of the Chemical War Council and served on several committees. Ever since that time, his opinions and judgment were held in such high esteem that he was appointed a member of the Executive Council of the American Chemical Society. In November 1924, the National Research Council Committee on the Construction and Equipment of Chemical Laboratories was organized and Father Coyle was elected Chairman of that Committee. Others who served on the Committee were L. M. Dennis, Cornell University, C. R. Hoover, Wesleyan University, J. N. Swan, University of Mississippi. After several years of intensive gathering of data and information the report of the Committee on the Construction and Equipment of Chemical Laboratories was published in 1930. The major portion of this work was done by Father Coyle. The tedious work of compiling and publishing the annual Ordo for the Society in the United States and Canada was generously performed by Father Coyle for about ten years.

The personal tributes expressed by his Brother Jesuits at the time of his death were most edifying. His outstanding qualities were his generosity and zeal for his work, his sincere charity and his love and devotion to the

Society. He taught chemistry for thirty-three years, a record seldom equalled. From the very beginning of its organization he showed the greatest interest in the American Association of Jesuit Scientists. It was partly through his efforts that the Association was founded. He never missed a meeting and his practical and sensible suggestions were always helpful and encouraging. His splendid work as Head of the Department of Chemistry at Georgetown University will ever be a monument to his zeal and generosity.

On Saturday morning, January 16, he was in New York City on business for the Medico-Chemical Foundation, and while there he had a sudden heart attack which brought his career to an unexpected close. Father Coyle has departed this life to receive his eternal reward and may his spirit of generosity, sincerity and loyalty to a noble cause be an inspiration to a future generation.

RICHARD B. SCHMITT, S.J.

REV. GEORGE L. COYLE, S.J..

Born: December 11, 1869; Philadelphia, Pa.

Early Education: LaSalle College, Philadelphia, Pa.

Entered the Society of Jesus at Frederick, Md., December 31, 1887.

1888-1890 Classical Studies at Frederick, Md.

1890-1891 Holy Cross College, Worcester, Mass.

1891-1894 Philosophy, Woodstock College, Woodstock, Md.

1894-1898 Professor of Chemistry, Gonzaga College, Washington, D. C.

1898-1905 Professor Chemistry, Theological Studies, Woodstock College, Woodstock, Md.

June 1901 Ordained to the Priesthood.

1905-1906 Tertianship, St. Andrew-on-Hudson, Poughkeepsie, N. Y.

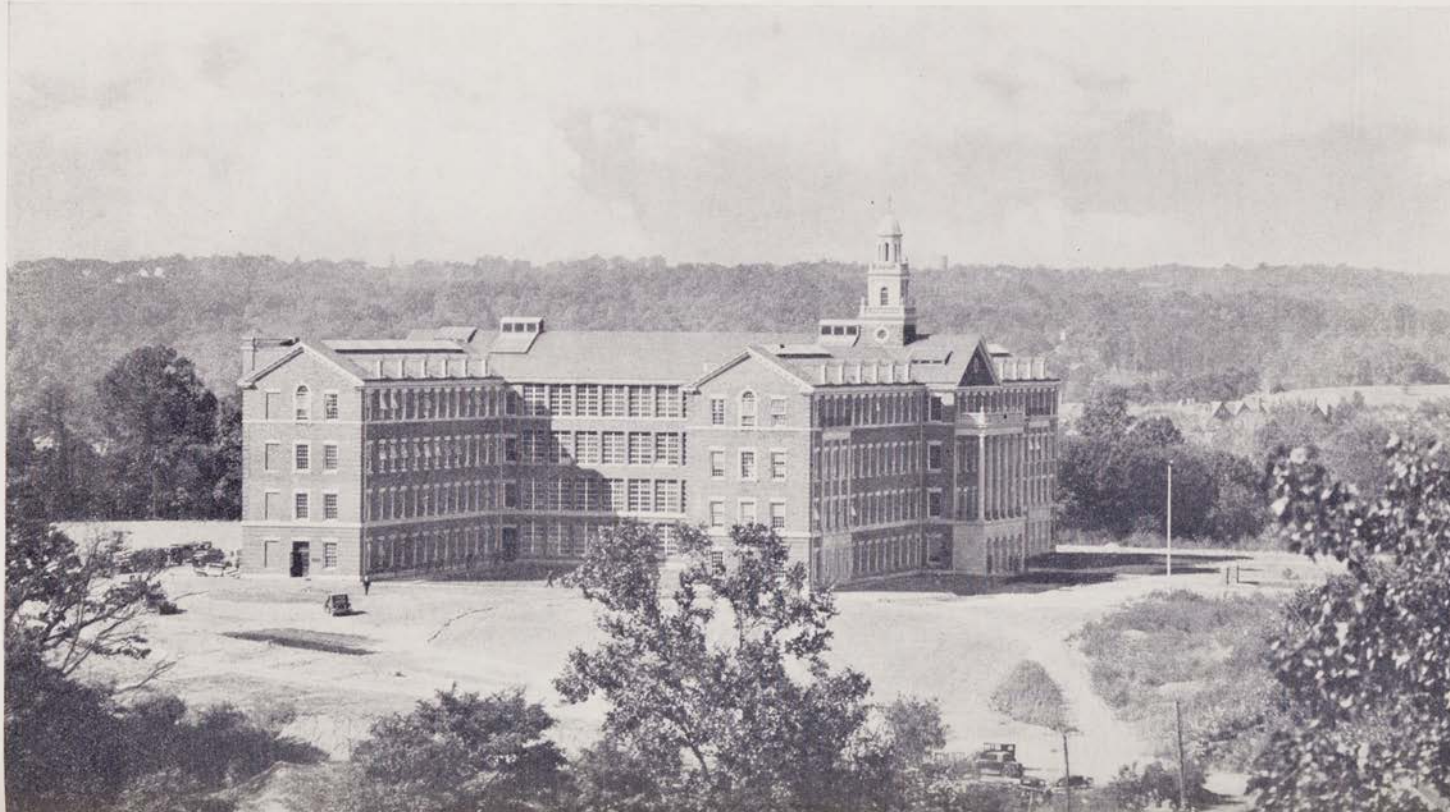
1906-1907 Research at the University of Göttingen, Germany.

1907-1923 Professor of Chemistry, Holy Cross College, Worcester, Mass.

1923-1932 Professor of Chemistry, Georgetown University, Wash., D. C.

Died: January 16, 1932; New York City.

Father Coyle was Professor of Chemistry for thirty-three years. The books he published: Notes on Basic Analysis; Notes on Acid Analysis; Notes on Dry Analysis; Laboratory Construction and Equipment. (National Research Council.)



Georgetown Medical and Dental School

GEORGETOWN UNIVERSITY

School of Medicine and Dentistry

To one familiar with Georgetown University Campus it is only necessary to say that the site chosen for the new Medical and Dental Schools Building was that formerly known as "Freshman Field". The advantages of this location are at once apparent if one bears in mind its situation at 39th Street and Reservoir Road, the latter now the principal thoroughfare west from Georgetown.

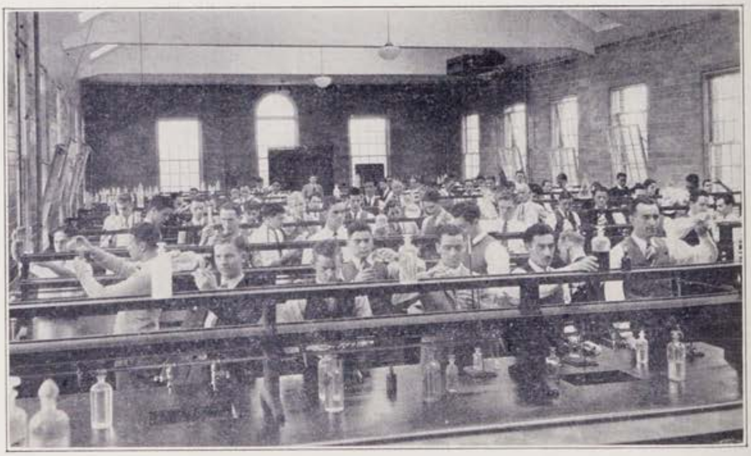
In keeping with the best traditions of Georgetown's southern background the Reverend Rector of the University and the Regent of the Schools in collaboration with Mr. George A. Didden, the architect, very wisely selected the dignified Maryland Colonial style with its imposing columns, for the new building. Built of red brick with sandstone columns and trim and ornamented with rich brass and wrought iron lanterns and balustrades, it presents a very stately appearance, rising on terraces over the quiet rolling hills of the middle Potomac valley.

To be certain of a constant maximum amount of light and air in so large a structure the H type of design was chosen. The building itself is 350 feet long and 400 feet in depth, rising to a height of four stories, the front elevation being surmounted by a cupola topped with a copper cross.

When the visitor enters the foyer, paneled to the ceiling in Royal Antique marble, through the massive double doors of heavy brass he is confronted by a carefully executed mosaic replica of the Great Seal of the University in the center of the block marble floor. Opening from the left of the lobby is the library with its steel bookstacks and its two-tone quartered oak furnishings, occupying the entire north-east wing where it secures light and ventilation on three sides. On the right of the lobby are situated the executive offices of the schools and conference chambers for its two faculties.

For obvious reasons of securing maximum light and the easy disposal of odors, all of the basic science laboratories are located on the fourth floor. Each department with it Professor's Office, preparation rooms and private laboratories, as well as the huge student laboratory with a capacity of 150, occupies one entire wing on this floor. The benches, tables and equipment were especially designed to meet the exacting requirements of each laboratory, by the various professors and the engineers of the Welch Manufacturing Company, by whom the installation was made. The building also includes four completely equipped dental techic laboratories, one for each of the four classes in that department. These are located in various parts of the building, convenient to the infirmary and class rooms.

Dental Clinic



Chemistry Laboratory

Like the basic science laboratories each piece of equipment has been specially drafted and manufactured to the specifications of the heads of the several departments.

The class rooms, twelve in number, vary in size from two large amphitheatres each with a capacity of 200 students to a group of four quiz rooms each accommodating 30 students. Half of the class rooms are equipped with opaque shades on the windows and roller projection screens to permit of the free use of the most modern visual educational methods. Others are provided with large flat topped lecture tables carrying sinks, compressed air, gas and outlets for alternating and direct current electricity as well as high tension current. All of the class rooms received special attention in acoustics and are provided with the most modern air circulation machinery.

The Dental Infirmary, which is always the room which holds the visitors attention, is situated on the third floor in the rear of the building where it commands a remarkable view of the University campus, the Potomac River, and the city of Washington. It is located in an unusually large room, 150x50 feet, finished with terra-cotta walls of warm buff color and a rubber tile floor of pleasing pattern. The 88 Ritter Dental units of the most improved construction and design, finished in grained walnut make a truly impressive sight. The sterilization room, immediately off the infirmary floor, is equipped with two Wilmot-Castle Sterilizers and a large Amercan Autoclave, all of the very latest and most approved design. The Oral Surgery and X-Ray departments of the infirmary are located on the second floor, immediately below the infirmary proper, as are the examination rooms, waiting and rest rooms for patients. All are equipped with the finest instruments and appliances procurable for use in their respective fields.

Because of the situation of the school it has been found necessary to include a cafeteria in the basement of the south-west wing where carefully prepared and tempting dishes are served to the students at very nominal prices.

ASTRONOMY

ECLIPSES OF THE SUN

Part II. Prediction, Observation, Results

REV. T. D. BARRY, S.J.

In Part I. of this article it was shown how eclipses of the sun can be predicted by means of the Saros, the period of 18 years, 10 or 11 days, 7 hours and 42 minutes, after which an eclipse will repeat itself. This period was discovered by the Chaldaeans, and was used very much in the prediction of future eclipses. It was probably of great assistance to Theodor von Oppolzer, a Viennese astronomer, who, in 1885, published his monumental work, "Canon der Finsternisse". This work gives the numerical data for 8000 solar and 52000 lunar eclipses occurring between 1207 B. C. and 2161 A. D. In addition he plotted on 160 charts the central lines of all the solar eclipses which cross the earth north of 30° south latitude. The late Father William F. Rigge, S. J., of Creighton University Observatory, Omaha, discusses the accuracy of the eclipse maps, in "Popular Astronomy" for February, 1926. He finds that the numerical data are remarkably accurate, but that great discrepancies can be had in the plotted paths of the eclipses. This he explains by the fact that Oppolzer plotted only three points for each eclipse, the beginning, middle and end, and that they were plotted on a north polar projection, that is, one on which the meridians are radial straight lines. On the scale used, 10 miles are represented by about 1/200 inch. The three points were then connected by a curve. If however the different points on the earth's surface are seen from the sun projected on a plane through the center of the earth, that is, by an orthographic projection, a more accurate picture of the phenomenon is had, and points between those plotted are displaced from the ones given by Oppolzer's north polar projection. Thus, in the 1932 eclipse, Oppolzer's path crosses the Gulf of Saint Lawrence and passes between Cape Breton Island and Nova Scotia, missing the United States altogether. As a matter of fact, it will pass near Montreal and cross New Hampshire and southern Maine. In spite of this, the "Canon" is of great value historically in placing eclipses of the past, and in determining the *fact* of future eclipses.

According to the present practice, the accurate prediction of eclipses and the computation of data necessary for local predictions is done by the Nautical Almanac Office at the United States Naval Observatory, and is published by agreement in the publications of several governments: "The

American Ephemeris and Nautical Almanac'' in the United States, ''The Nautical Almanac and Astronomical Ephemeris published by the Royal Observatory at Greenwich, ''Connaissance des Temps'' in France, ''Berliner Astronamisches Jahrbuch'' in Germany, and ''Almanaque Nautico'' published by the Spanish Naval Observatory at San Fernando.

The method of prediction was invented by the great German astronomer Bessel, and consists essentially in imagining a plane through the center of the earth perpendicular to the line joining earth and sun, and projecting the motion of the moon on that plane. The center of the earth is regarded as the origin of coordinates, the intersection of the above-mentioned plane (called the fundamental plane) with that as the equator as the x-axis, the y-axis being perpendicular to it and directed toward the north. In the Ephemeris are given for every ten minutes of Greenwich Civil Time the following data: the coordinates x and y of the center of the shadow on the fundamental plane, the log sin and log cos of d (the declination of the sun as seen from the moon), mu (the Greenwich Hour Angle of that point), and the radii on the fundamental plane of the shadow, or umbra, and of the penumbra, which is the circle within which the eclipse is seen as partial. For every hour of G. C. T. are given the logarithms of the variations per minute in x, y, and mu, and the log tangents of the angles of the cones of the umbra and penumbra. In all cases the radius of the earth is taken as unity. With the aid of these Besselian elements, numerical computation gives the local circumstances of the eclipse, namely, the times of the four contacts (to be explained below) in the case of a total or annular eclipse, or of the first and last contacts and of the maximum obscuration if the eclipse is partial, the magnitude of the eclipse, and the position angles, reckoned from the north point or from the vertex of the sun westward to the points of contact. The Ephemeris also prints for five-minute intervals the geographical coordinates of the northern and southern limits and of the central line of the total or annular phase, and the duration of that phase along the central line. A chart showing the region in which the eclipse is visible is given, as well as a table giving the local circumstances for a number of cities in United States territory. A sample computation for some location is worked out in full. In the event that the path of totality crosses part of the United States the Nautical Almanac Office puts out a special eclipse supplement to the Ephemeris, containing, in addition to the above data, meteorological information giving average weather conditions at points along the path for use in the selection of a place of observation, a chart of the sky in the vicinity of the eclipsed sun showing the planets and brighter stars in the neighborhood of the sun, and a large scale Geological Survey map with the path of totality and other data printed in. The supplement is sold by the Superintendent of Documents, at the Government Printing Office, for 25 cents, though the Superintendent of the Naval Observatory has a supply for free distribution. A copy may be had on application. The four contacts mentioned above are: first contact, when the limbs (edges) of moon and sun are externally tangent, marking the beginning of the partial phase of the eclipse; second contact, when the two limbs are internally tangent, marking the beginning of the total phase; third contact, when the two limbs are internally tangent but on the opposite side, marking the end of totality; and fourth contact, marking the end of the eclipse.

The exact second at which the eclipse begins is hard to determine, since the first indication that the phenomena is under way is had when a very small section of the sun is hidden by the moon. This is visible only after the first contact has already taken place. The eclipse expedition of the Mount Wilson Observatory to Honey Lake, California, on April 28, 1930, used for the first time moving pictures with sound record. The Fox Movietone News took the pictures at the rate of twenty-four exposures per second, while the voice of an observer counting off the time was recorded on the sound track. By this means an accurate determination of the times of the contacts was made. As the eclipse progresses the arc of the advancing moon obscures more and more of the sun, until after about an hour only a very thin crescent of the sun is still visible. An eerie darkness begins to cover the landscape, since most of the source of light is hidden, chickens are deceived by the darkness and go to roost, and the planets and brighter stars begin to make their appearance in the sky. As the time of second contact approaches, the shadow is seen to sweep down on the place of observation at the astounding speed of over 1,000 miles an hour. Just ahead of the shadow itself are the so-called shadow bands, a series of alternate bands of light and shadow, which are attributed to the refraction of the light rays along the edge of the shadow due to the difference in temperature inside the shadow and outside where the few remaining rays of the sun still exert some heating effect. Another phenomenon, known as Baily's beads, is visible for a few seconds immediately before the sun completely disappears. The limb of the moon is not a perfect circle, because of its mountainous nature. This makes for a rough edge, and just before totality the raised portions on the limb seem to reach out toward the edge of the sun, in a manner similar to what happens to the shadow of a hand in the sunlight when the fingers are brought together. Before the fingers come into actual contact the shadows are joined, by the phenomenon of irradiation. When this effect is seen at an eclipse, the last rays of the sun shining between the mountains appear as beads of light and take their name from Francis Baily, who first observed them at the eclipse of 1836. Finally all the light of the sun is cut off by the advancing moon, and the total phase of the eclipse is under way. There, in the heavens, is the black disk of the moon, surrounded by the corona. This is a pearly-white glow of light surrounding the sun, and extending to a considerable distance from it. Close to the moon may be seen the solar prominences, great tongues of flaming gas, many times the size of the earth, which shoot out from the sun at terrific velocities, although due to the great distance of the sun, it takes considerable time for any motion to be noticed. The prominences at times take phantastic shapes, as in the eclipse of 1918, when one of them looked like an eagle alighting on a cliff. When the end of the totality arrives, suddenly the blinding glare of the reappearing sun is seen, the corona and prominences disappear, and the other phases of the spectacle mentioned above repeat themselves in reverse order.

To see an eclipse of the sun, all that is needed by the lay observer is a piece of smoked glass or a developed photographic negative. These are necessary during the partial phase in order to keep the eye from being blinded by the sun's rays, but during the eclipse proper the phenomenon may be witnessed with the naked eye. For a professional astronomer, on the other hand, much more extensive preparations must be made. Since the scene of an elipse is more frequently than not thousands of miles away from home, and since the spectacle happens so rarely and lasts for such a short time, careful planning is the order of the day. He must choose a suitable location, decide what observations are to be made, what instrumental equipment is requisite for the proper carrying out of the observations, and the means by which the weighty but delicate instruments are to be safely transported to the site decided upon. In the choice of site weather conditions and accessibility are of paramount importance. Weather reports at different places for the day of the eclipse and for the time of the day, collected through a number of years, are collated and the chances of clear weather at the time of the eclipse are carefully weighed, in order to make as certain as possible an unclouded sky during the precious moments. The instruments must be carefully selected, regard being had to the most economic transportation. Spare parts and tools must be included, otherwise it is rarely possible to replace them at a moment's notice. As for transportation, governments are frequently very generous in putting their naval resources at the disposal of the scientists. Once the equipment is landed, and that frequently causes difficulty due to lack of harbor facilities, as is the case of many islands in the East Indies, it must be set up. Local governments cooperate in this work by providing transportation and labor. Concrete piers must be set up to provide stability for the instruments, shelters against wind and rain must be constructed, and all must be finished in time to focus the instruments and to practice the method of procedure, in order to have the greatest efficiency during the eclipse. Regular "dress rehearsals" are held, during which somone counts off the seconds, and the members of the expedition go through their appointed tasks, loading photographic plates into the instruments and removing them, making various readings, and so on, so that no hitch may occur during the real show.

Even after all this preparation, the expedition may come to nought. The weather is the greatest offender in spoiling the efforts made by the astronomers. Days and even weeks of clear weather may precede the event, and then, by some perversity, an hour or so before the scheduled time of the eclipse, dense clouds begin to pile up, and the observers can do nothing but twirl their thumbs for their pains. In 1923 an eclipse occurred in southern California, which according to all reports enjoyed the most perfect weather on earth. Nevertheless, on the day of the eclipse, "exceptional" weather prevailed, clouds spoiling everything except in the case of a very few lucky parties. On other occasions the work of the observers has been seriously hampered by the natives of the district, who insisted on crowding around to inspect the operations.

The objects of observation are varied. First in line come the times of the contacts. These are predicted as closely as possible, but if either the sun or the moon is late for the appointment or comes too early, the matter must be looked into. There is usually not much difficulty in predicting the place of the sun at any time, but the moon is causing the mathematical astronomers some worry. The prediction of the position of the moon requires the computation of a large number of terms, yet in spite of the refinements used there exists at present a discrepancy of 5″ or 6″ between the predicted and the observed positions. The accurate timing of the four contacts gives some data from which it is hoped to trace the error to its source. It is for this same purpose that the present intensive campaign for observing occultations of stars by the moon is being undertaken. The latest discussions seem to place the burden of the blame, not on the moon, but upon the earth. It is now claimed that the latter shrinks and expands slightly, exerting a force on the moon which affects its position. The data obtained from the observation of occultations was of material help in predicting the path and the times for the total phase of the central eclipse of April 28, 1930. Since the maximum duration of that phase was only 1.5 seconds, it is evident that to obtain any results at all from the eclipse those circumstances had to be known with a large degree of precision.

Photography of the corona is of great importance in the observational program. Long focus lenses are used to give larger images. Two arrangements are in common use. In one method the telescope tube is directed at the point in the heavens where the middle of the eclipse is to take place. The motion of the eclipsing bodies is compensated for by moving the photographic plate in the opposite direction. Another arrangement is to lay the tube horizontally along the ground, and introduce the rays into it by means of a coelostat, a plane mirror which is driven by clockwork so as to reflect the rays always in the same direction. This obviates the necessity of moving the plate during the exposure. If the time allows, several exposures of different lengths are taken. Short exposures are used to observe the prominences and the details of the inner corona. To obtain details of the outer corona, longer exposures are required, although they are useless for the inner corona, the plate being "burned out" in that region. The corona exhibits a number of interesting forms at different eclipses. They have in general been divided into two classes, the first showing long streamers extending equatorially and short plumes going out from the poles of the sun, the second having shorter equatorial streamers and longer polar rays, so that the whole takes on a more or less circular form. Of course the shape is not duplicated in any two eclipses, and since the light is much stronger close to the sun than at a distance different exposure times give slightly varying shapes for the same eclipse. It has been found that in general the first type mentioned is found when sun spots are at a minimum, and that at sunspot maximum the latter form is prevalent, so that the shape can be in some measure predicted. Various theories have been formulated to account for the presence and appearance of the corona, which can be outlined here only in brief: 1) the meteoric hypothesis, according to which the light comes from meteors falling into the sun; 2) the mechanical theory, propounded by Schaeberle, which says that the light is emitted and reflected from particles of matter ejected from the sun; 3) the magnetic and electro-magnetic theories, proposed by Bigelow and Ebert respectively, because of the similarity in appearance with the lines of force around a magnet; 4) the radiation-pressure theory, according to which small particles of matter are repelled from the sun by the force of the light emitted from that body (this theory is also used to explain the fact that the tails of comets are always directed away from the sun); 5) the electron theory, which explains the phenomenon by a photoelectric effect. The sun, having a very high temperature, is highly ionized, and consequently emits millions of electrons, which in turn impinge on minute particles of matter in the vicinity of the sun, thereby losing some of its energy, the transfer being characterized by the emission of light, electromagnetic and photoelectric effects, etc. The weight of opinion leans strongly towards the last theory, though the radiation-pressure theory has considerable evidence in its favor.

Photography of the corona also includes the use of colored filters, and of polarizing apparatus, the latter to determine the amount of light that is reflected from the sun by the corona. Much attention is also paid to the spectrographic program. The spectrum of the uneclipsed sun is continuous, crossed by a very large number of dark lines. This is explained by the fact that the photosphere, or surface of the sun, being incandescent, gives a continuous spectrum, while light of certain frequencies is absorbed by the burning gases of lower temperature just above the surface, giving rise to dark lines. The gases themselves would ordinarily give a bright line spectrum. C. A. Young, at the eclipse of 1870, first observed this latter spectrum. As it is visible only for a few seconds after the beginning and before the end of totality, it has been named the flash spectrum. As the portion of the sun's atmosphere which causes this effect is very narrow, a slitless spectroscope is employed, the resulting lines being curved images of the reversing layer, as it is called. The spectrum of the corona itself, is the continuous spectrum of the reflected light of the sun, with a few bright lines superimposed.

Other observations at the time of an eclipse include photometric determinations of the light of the corona, bolometric determinations of its heat, meteorological observations, such as the drop in temperature as the shadow of the moon reaches the eclipse site, and photographs taken to attempt to verify the "Einstein shift". Einstein declared that, due to the heavy gravitational effect of the sun, the light of the stars in the neighborhood of the sun must be bent, the total deflection amounting to 1.75 seconds of arc at the sun's limb. To test this effect, photographs of the vicinity of the sun are taken at the time of the eclipse, and again, to the same scale, a few months before or after the eclipse, when the sun is in another part of the heavens.

The results accruing from observations of an eclipse are many and varied. A few of them will be mentioned here. The times of the contacts, as mentioned above, are used to determine the moon's position with greater accuracy. At the eclipse of 1918, the first contact occurred 14 seconds ahead of scheduled time; at that of 1925, it was 5 seconds ahead of time; in 1930, with the help of data obtained from the observations of occultations, the prediction came within two seconds. Observations of the brilliancy of the corona show that the total light is somewhat less than that of full moon, although the results vary at different eclipses and with different methods of observation. The "flash spectrum" has given valuable data in the determination of the relative heights of the layers of gases causing the many lines in the spectrum. Spectographic observations of the prominence and of the corona have even led to the discovery of new elements. At the eclipse of 1868, a strong line near the location of the D lines of sodium started a great deal of speculation as to its origin. It could hardly have been caused by sodium which is too heavy to exist at the height above the photosphere at which the line was observed. No other known element could have caused it, the conclusion remaining that it was due to some element as yet undiscovered. In 1895 the riddle was solved by the discovery of helium, which is of such tremendous importance nowadays in filling lighter-than-air craft. In 1869 the green region of the spectrum showed another line not belonging to any known element. It was provisionally termed "coronium" and has defied identification until recently. I believe that it has finally been traced to a common element, emitted under very abnormal conditions, though I am at present unable to locate the reference. As for the verification of the "Einstein shift", rather contradictory reports have come in. British observers at the 1919 eclipse claim to have fully verified it, as did also the Lick Observatory in its bulletin describing the results from the 1923 eclipse. But Professor Charles Lane Poor, recently of Columbia University, vehemently attacked the results of the latter, on the grounds that the Lick astronomers deliberately excluded from consideration data which would militate the verification of the shaft of the stars, in other words, they presupposed the "probanda". An acrid controversy ensued, which eventually founds its way into Scribner's Magazine. Professor Poor claims that if the shift actually exists it can be explained fully by the Newtonian law of gravitation, without the help of Einstein's relativity. So at present the question is still "sub judice."

For further information on eclipse observations, see the Bulletin, Vol. VII., no. 2, p. 20, an article entitled, "Some Eclipse Hints", by Father Charles Deppermann of the Manila Observatory.

The next paper in this series will treat in detail of the coming eclipse of August 31, 1932.

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N. B. Correction to the previous article.
On page 64, line 8: for 50° 8′ read 5° 8′.

EDITORIAL

Continued from page 106

pecially interesting to Dr. Arthur I. Kendall of the Northwestern University Medical School who developed a new medium "k" on which invisible organisms grow and become observable in a microscope of this kind. This medium containing protein should lead to new concepts of the nature of this elusive organism.

In chemistry, the past year will probably be remembered as the year of the three-corner claim to the discovery of element 87 by Professor Allison, Professor Papish and Danish scientists. Professor Allison, originator of the magneto-optic method established first claim, but his device is still unsubstantiated in the hands of independent research workers. Professor Papish, on the other hand, used the method of X-ray analysis, much less sensitive, but more orthodox. The controversy, still unsolved, was precipitated further by the announcement of Professor Allison that he can detect the last unknown element number 85.

Geologists worked on the long sought answer to the question, "How old is the earth?" A committee of the National Research Council working on the problem arrived at an estimate of 2,000,000,000 years by considerations of radioactive substances present in the earth. Also in geology came the discovery of a visitor from outer space when the world's largest meteor yet found was unearthed in Africa. This meteor, weighing eighty tons, is a mass of iron and steel.

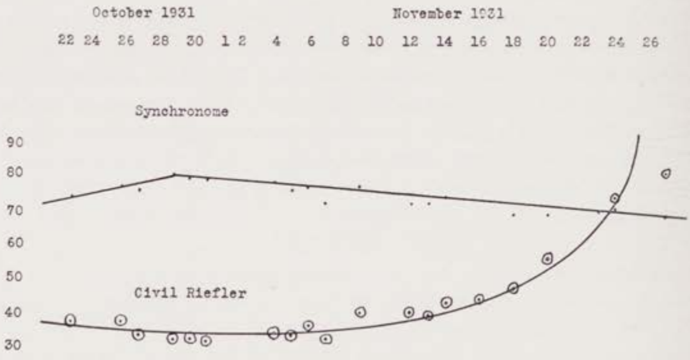
The late Father Coyle was an ardent advocate of "the march of science." This was evidenced in the zeal he manifested for the realization of a great medico-chemical research laboratory where he hoped for progress in the vast field of the application of chemistry to medicine in order to relieve suffering humanity. May his zeal and spirit of progress inspire the research workers in science.

THE MASTER CLOCKS OF THE MANILA OBSERVATORY

REV. CHARLES E. DEPPERMANN, S.J.

As already stated in another issue of the Bulletin, the Observatory possesses three astronomical master clocks, one Synchronome and two Rieflers. These were all placed on one massive adobe pier, the pendula being about two feet from each other, and all swinging in different planes, though on the same face of the pier. The rates of the clocks were far from satisfactory, but the true cause could not for a long time be even suspected. The key to the situation was provided by a perusal of the excellent articles by Loomis and Dr. Brown in "Monthly Notices of the Royal Astron. Society" (March 1931), concerning the rates and possible mutual interference of rates between Synchronome clocks even on different piers. If this could happen even in the extreme case mentioned, what might be expected in my case, with all clocks fairly close together on the same pier.

Upon examination and careful plotting of the rates of the three clocks of the Observatory, it was found that a good case could be made out for mutual interference as follows: a) Whenever there was a difference of phase of 0.30 sec. between the Synchronome (Civil Time) and the Civil Time Riefler clocks there was a perceptable change of rate in all three clocks. b) The curve of clock rate between the rate changes often showed a complete sine wave.



How explain change of rate for all three clocks? The only reason I can see is this: Resonance between the Synchronome and the Civil Time Riefler was set up violently at a definite phase difference between the two, enough probably to widen a possible crack in the adobe pier (other adobe walls in the Observatory show cracks with age). This in turn tilted the side of the pier enough to cause a change in rate of all three clocks. Whatever may be said about the crack, the simultaneous change of rate of all three clocks seems a fact; this change of rate may be traced through at least ten periods.

The plots with explanation were sent to Dr. Brown of Yale for examination, and just lately his reply was received. In brief, he replied: a) there were evident signs of interference between the clocks; b) due to other imperfections of clock rate, however, the plots did not warrant extended mathematical treatment (my own opinion already expressed to Dr. Brown) c) change of rate may occur for other reasons than the one given; d) best proof would be to set clocks up on different piers and note the change. Lick Observatory had similar difficulties lately, and got rid of them by putting the clocks in different buildings.

In the meantime, I had already been changing my clocks to separate piers. Two massive piers in a new clock vault were built, one pier for the Synchronome and one for the Civil Time Riefler; the Sidereal Time Riefler was kept on the old adobe pier, but on a different face of the same. Due to the fact that the change had to be made slowly, during the rainy season, it took time to get the clocks into any sort of shape. Besides, we had two accidents with the Synchronome. Two of the bell-jar tops caved in during the middle of the night, right on top of the works. The force was enough to imbed some of the glass in the brass of the mounting of the clock works! The breaks were due to poor annealing combined with too flat a top for the bell-jars; since only the tops of the bell-jars caved in, leaving the lower portions even uncracked, there could be no question of any carelessness on our part, allowing grit to come in between the bottom of the bell-jars and the top of the vacuum case. The main damage to the clocks was the following: a) thermometer and vacuum gauges broken; b) impulse wheel dented; c) main suspension spring very considerably bent; d) cores of magnets permanently magnetised due to continuous run of current through them until the accidents were discovered. A temporary vacuum gauge was home-made, the impulse wheel was provisionally straightened out, as was also the delicate and important suspension- spring, leads of the magnet reversed and a little slip of paper put at end of the iron cores and lo! the synchronome was put to work again!

I know of no better encomium for the Synchronome than its straight line rate curve for the past month, in spite of the fact that the impulse wheel and spring are not in the best of condition. I send a diagram of its rate on a separate sheet, each little square being a hundredth of a second. The little deviations of the crosses (marking clock error as observed from star transits) from the straight line are not due, I think, to the clock, but rather to the transits, for we have been having quite cloudy weather, and some of the transits were taken through thin clouds and otherwise poor sky. The kink in the curve on October 28th is quite interesting. On that day at 2 P. M. there was a quake at the upper end of Luzon, not enough to be sensibly felt at Manila, but still enough to give a very large record on our Weichert seismograph. Now the Slave clock of the Synchronome faces north, so that the pendulum got the full brunt of the transverse waves; the Master Synchronome was perpendicular thereto and got little. Two to three hours after the quake, I discovered that the Slave had been thrown out of synchronization with the Master, but that both clocks were still going. The Slave was put by hand into synchronization with the Master again without stopping either clock. The **error** of the Master seems to have been negligible, but note the **change of rate**. A tilt of the pier, due to the quake, seems improbable; the explanation is rather to be sought in this, that in setting the Slave and Master into synchronization again, the phase difference between the two became slightly different from what is was before.

As noted from the diagram, the Civil Riefler, even on its new pier, seems to be following a curved rate (prabably a conic section). It may be that the pier has not yet fully settled; the pressure, temperature and time of resetting of the lever have all remained constant. The Sidereal Time Riefler, still on the old pier, is as erratic as ever.

From the excellent rate now kept by the Synchronome on its new, separate pier, it seems quite justified to state that the original fluctuations of rate were due to mutual interference between the clocks on the same pier.

BIOLOGY

THE EVOLUTION OF DOMINANCE

Charles A. Berger, S. J.

Several English scientists have in late years been trying to formulate a new theory of evolution from the findings of modern genetics. Their methods, differing in minor respects, agree in attributing to natural selection the major role, and in finding a difficulty in the genetic phenomena of dominance and recessiveness. Dr. R. A. Fisher of the Rothamsted Experimental Station has proposed a theory to explain the difficulty. Briefly he holds the evolution of dominance by the natural selection of modifying factors. We will take a quick glance at his entire system of evolution, and then examine his theory of the evolution of dominance in more detail.

He rejects all theories of evolution in which some physiological agency plays the important role, and states that natural selection alone is the important factor. Since acquired characters are not inherited, and since mutations of themselves are incapable of directing the course of evolution, this course must be determined by natural selection picking out those mutations which are to be incorporated into the species. On this scheme the present day dominant wild-type genes must be supposed to have arisen as mutations. Mutations however are usually recessive, hence the problem of explaining how these originally recessive mutant genes became dominant members of the present wild-type gene-complex.

Fisher's explanation is that natural selection picks out those individuals in which modifying genes are present, accentuating the beneficial effect of the mutation in question. In the same way harmful mutations are selected against until they are completely recessive, or, if the process has gone on for a sufficiently long time, until the harmful effect is entirely eliminated. This process of natural selection of modifiers acts much more strongly on heterozygotes than on homozygotes, due to the relatively greater abundance of the former in nature, especially during the early history of the mutant gene. The mutations we have found in the laboratory must have occurred many times in nature, and natural selection of their modifying factors must have gone on throughout a considerable portion of the history of the species, with the result that the mutant gene itself, or, as would more frequently be the case, its wild-type allelomorph, acquired complete dominance. Thus is explained the dominance of present-day wild-type genes when crossed with the supposedly new mutations we find in the laboratory. Thus also is established a certain amount of heterozygosity in the gene-complex of natural species, so necessary for the working of this theory.

Let us review briefly the little we know about modifying factors. Modern genetics has discovered three different types of modifying genes:

1. *Multiple allelomorphs*: a series of different mutations at the same locus, any two of which may act as a pair of allelomorphic genes. Any two have a characteristic effect, and only two can be present at the same time. A good example of this case is the series of eleven allelomorphic genes for eye-color at the white locus in *Drosophila melanogaster*.
2. *Multiple factors*: several factors with a similar but cumulative effect. These factors are not allelomorphs, but are members of different pairs of factors in different loci. For example eye-color mutations in Drosophila have occurred at 15 different loci, and different combinations of these give a variety of summation effects.
3. *Specific modifiers*: these are genes which do not produce any *appreciable* effect, even in the homozygous condition, except in the presence of *certain* other genes which they modify. Bridges has found several specific modifiers for the eosin-eye character in Drosophila.

Dr. Sewall Wright of the University of Chicago has criticised Fisher's theory of the evolution of dominance by the selection of modifying factors as follows. He holds that such selection would be an evolutionary force of the third order, coming after direct selection and mutation frequency, and would be inefficacious in directing evolution. He points out that the fate of any factor is determined by the net effect of the opposing evolutionary forces working on it, and that practically this means that the determining is done by the most important of these forces. Now the selection pressure acting on a specific modifier is admitted by Fisher to be of small intensity, and as Wright points out, this minute force would be rendered ineffectual by at least two much more important forces, 1st—direct selection acting on the gene that is being 'modified', and 2nd—the natural mutation rates of the original mutant gene and of its modifier. Furthermore in view of the evidence that is being accumulated showing that all genes have multiple effects, Wright considers that modifying genes also would be subject to direct selection on one or other of these effects, and that this direct selection would render ineffectual any minute third order selection value the gene might have, due to its capacity to modify the dominance of another gene. Wright holds that we have no evidence that there are genes so neutral to all other evolutionary forces (direct selection, mutation, etc.) that the minute selective value they have as modifiers is the most important force acting on them. "A fortiori" we have no evidence that such genes exist in the abundance required by Fisher's theory.

The essential weakness of this third order type of selection remains a fact as long as the frequency of the heterozygote is small compared to that of type. If the proportion of heterozygotes equals that of type, the selection of modifiers acquires the force of direct selection. This condition may be had in artificial selection and domestication, but is not the case in nature.

For these and other reasons given in his original papers (Am. Nat. *63*, 274, and *63*, 556) Wright concludes that the phenomena of dominance and recessiveness are not statistical consequences of natural selection. He rather inclines to the view that dominance is the result of something inherent in the physiology of gene action. Although the presence and absence theory in its original form has long been abandoned, a somewhat similar idea is now held by many geneticists, namely, that the most frequent type of change in genes is a negative change resulting in the partial or complete inactivation of the gene. It seems probable for physiological reasons that inactivations of this kind would normally behave as recessives.

It will be noted that Wright's criticism is directed against the theory of the evolution of dominance itself. In other words Wright contends that granted the principle of natural selection, it would not work out in nature in the way Fisher claims. It is also illuminating to note that both Fisher and Wright use biometric methods, and from their rather intricate mathematical reasoning obtain similar results, yet when it comes to interpreting these results their conclusions are contradictory. This exaggerated application of higher mathematics to biological problems in nature is not only useless but misleading. A formula that is capable of contradictory interpretations is certainly useless. It is misleading in that it creates the impression of exact treatment, certainty and finality, in problems that teem with unknowns and 'unknowables'. Who shall determine the value of n, the number of individual in a species in nature? Who can determine with any degree of accuracy the mutation rate of any gene in nature, or the selective value of any mutation? Will we ever be able to determine these values? Years ago Mendel showed us how far mathematics could be used with certainty in genetics, and this limited use, together with the application of the experimental method has resulted in the development of genetics into an exact science. It would be foolish indeed to leave the fruitful method of experimentation for the devious paths of mathematical speculation.

We can criticise Fisher's theory of dominance, and also his entire scheme of evolution, on a still more essential point. The principle of natural selection is not and has never been an established law of nature. The negative action of natural selection in weeding out the unfit is admitted by all to have a very large application in nature, but from this fact it does not follow that the fittest will always survive. One has but to consider the modern concept of the individual as resulting physically from the action and inter-action of several thousands of genes to realize that a harmful mutation in any one of these will result in an individual more or less unfit. On the contrary however, a beneficial mutation, such as the increased activation of a gene, to be beneficial to the whole organism, must give a favorable (or at least not harmful) reaction with all the thousands of other genes in the gene-complex. In other words the old Scholastic dictum "Bonum ex integra causa, malum ex quocumque defectu" certainly holds here. Any mutation that is harmful, either in itself or in any of its relations to the gene-complex, will result in a more or less unbalanced or unfit organism. A beneficial mutation must not only be such in its specific effect, but also in all its multitudinous interactions with the gene-complex. Obviously mutations fulfilling all these exacting requirements will be very rare indeed.

We come then to the concept of a species existing in nature as consisting of three classes of individuals: 1st—a large class having harmful mutations and being more or less unfit to survive in the competition of nature; 2nd—an extremely small class with beneficial mutations; and 3rd—by far the largest class consisting of all the remaining individuals having neither beneficial nor harmful mutations. Since we cannot be more definite in our description of these classes, one sees at once the futility of attempting to express them in mathematical formulae. On the first class the negative action of natural selection will have a large effect, and many of these will not survive. If we consider only one or other of the factors entering into survival, we might arrive at the conclusion that the positive action of natural selection will preserve some of the beneficial mutants, but if we try to see nature 'whole' we will see that the factors entering into the survival of an individual are as numerous, and have as many interactions, as the genes in the gene-complex. Hence we see that anyone of the rare 2nd class individuals to be assured of survival, must pass through a second series of exacting and interacting conditions, as numerous as those of the gene-complex. After passing through these two series of almost impossible conditions, this most fortunate of organisms would still be subject to chance elimination by any of a number of purely fortuitous agencies. Hence we see that chance rather than the positive action of natural selection, decides the survival or elimination of individuals of the 2nd and 3rd class.

I have often wondered why no one has ever developed a theory to explain the constancy of species by the action of natural selection. It is quite possible without stretching the imagination to conceive situations in which those very beneficial mutations, to which evolutonists ascribe survival value, would be the cause of the individuals elimination, it is also quite possible to find these situations not uncommonly in nature. Thus we should have the paradoxical conclusion that natural selection acts by weeding out the fittest as well as the unfit, and in granting survival to those individuals which depart least, or not at all, from the norm of the species. I do not say that I hold this theory, but I do say that it could be just as plausible as that of the ORIGIN OF SPECIES THROUGH NATURAL SELECTION.

N. B.—The writer would welcome comment or criticism on the ideas and problems discussed in this paper.—C. A. B.

THE PARATHYROID GLANDS

Rev. George J. Kirchgessner, S. J.

The Parathyroid glands are minute bodies more or less closely attached to the thyroid glands. They vary in number, size and position in different species of animals and also in different individuals of the same species. They are found in all the vertebrates except fish. In man, they are usually four in number, although the number may vary from one to eight. In size they range from 3 to 15mm. in length and are usually about 2mm. in thickness. They are generally attached to the posterior surface of the thyroids, the upper pair about one-third of the distance from the top of the thyroids and the lower pair about the same distance from the bottom. The upper pair may be embedded in the thyroid tissue and the lower pair and accessories may be some distance below the thyroids. Parathyroid tissue may even be found embedded in the thymus gland. Often they are difficult to distinguish from the thyroids, especially if there has been any bleeding, and sometimes there has been difficulty in distinguishing the two kinds of tissue under the microscope. However, there is no doubt as to their real distinction, since they differ in their embryological origin and also in the effects which follow their removal.

Their small size, inconspicuous position and the similarity to the thyroids, caused them to be long overlooked or at least disregarded. The same factors, together with their variability, make it extremely difficult to avoid error in experimentation. This may account for the contradictory conclusions of early and even present-day workers.

The complete removal of the parathyroid glands is followed by a disease called tetany, which is followed by death in from 2 to 15 days. A small amount of parathyroid tissue, left behind prevents the appearance of the symptoms of tetany. The removal of the thyroids does not produce tetany but another disease called myxedema. When tetany is caused by the removal of the parathyroids, the animal usually recovers from the anesthetic perfectly in 24 hours. If watched carefully, it is seen to show signs of restlessness and anxiety. Fibrillary tremors can be felt in the head and shoulder muscles. These become visible and the animal may pass rapidly into a condition in which all the muscles are in rigid spasm. Sometimes the progress is more gradual and the animal passes through a stage of St. Vitus' dance-like convulsions. Exhaustion may supervene in a violent attack and the animal may remain quiet sometime before death or it may succumb at the height of the seizure. Not infrequently, the animal will recover from one attack and remain apparently well for hours or a day or more, until the next attack.

Tetany appears in many forms and degrees of acuteness and is not always caused by the abscission of the parathyroid glands. It may be epidemic. It is epidemic in Vienna and Heidelberg. It may occur in both sexes and at any age, but is more frequent and violent in the young. It is characterized in humans by hyperexcitability of the nervous system (motor, sensiry and sympathetic) and may be detected in latent or chronic cases by characteristic cramped positions assumed by certain sets of muscles when the controlling nerve is compressed, such as the so-called obstetrical hand, or by spasms in the muscles when the controlling nerve is irritated, as in the face muscle when the facial nerve is tapped. Most students of the subject hold that all forms of tetany are caused by diminution or suppression of parathyroid function.

There are two principal theories advocated in attempting to explain the action of the parathyroids in preventing tetany—the calcium deficiency theory and the toxic theory.

According to the calcium deficiency theory, the secretion of the parathyroids regulates the metabolism of calcium or lime in the body in some way at present unknown, and when this control is interfered with, there is a deficiency of calcium in the tissues. The main argument in support of this idea is the undoubted fact that the injection of the soluble salts of calcium give immediate relief from the nervous symptoms of tetany. This however, is only palliative and does not save life. The strongest objection to it is that other elements, magnesium, strontium, and even the poisonous barium are as effective as calcium. Another objection is that simply bleeding the patient and replacing the blood by an equal amount of a calcium free solution of sodium chloride will also bring prompt relief.

The fact that bleeding alone relieves the symptoms of tetany, favors the toxic theory. Guanidin is the poison most commonly thought to be the cause according to this theory. The main facts in favor of the guanidin intoxication theory are: first, that tetany symptoms may be induced by the injection of soluble salts of guanidin; secondly, that guanidin is greatly increased in the blood or urine of animals suffering from tetany; and thirdly that nerve muscle preparations are affected alike by solutions of guanidin and by the serum of animals suffering from tetany.

Some authors hold that the thymus gland produces a secretion that causes tetany if the parathyroid function is defective. In favor of this view is the fact that the young are more subject to tetany, than the old, that pregnancy sometimes brings on tetany and that thymus extract has been found to produce tetany symptoms.

Extracts from the parathyroid glands have been made and found useful in alleviating attacks of acute tetany and the extract has been used experimentally in many other ailments. The active principle in the extract has been used experimentally in many other ailments. The active principle in the extract has not been isolated. The administration by mouth of fresh or dessicated parathyroid gland has also relieved tetany. It is believed by some, that the only permanent cure for acute tetany is the transplantation of parathyroid tissue. A large parathyroid gland of an animal of the same species is used and is usually implanted in the abdominal muscles. The operation sometimes causes damage to the donor of the tissue.

In this paper, I have relied for the most of my facts on the book, 'Endocrinology and Metabolism' edited by Dr. Lewellys F. Barker. The recent literature on the subject seems to be concerned mainly with testing the calcium deficiency theory and the guanilin intoxication theory as to the action of the parathyroid glands.

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TERMITES OF THE SOUTH

REV. JOSEPH ASSMUTH, S.J.

The occasion of the annual meeting of the American Association for the Advancement of Science gave me an opportunity of not only attending lectures, meeting scientists, examining various exhibits, etc., but it was also an opportune time for the study of the Termite Fauna of the South which is so rarely represented in the Northern States.

In one respect the region which I visited proved, quite contrary to my expectation, to be poor in the variety of forms represented: I found, in fact, only one single type, the common American wood destroyer Reticulitermes flavipes Kollar. But the paucity of species was amply compensated by the abundance of colonies of this Termite. They were much in evidence in the grounds of Loyola University, and still more so in Spring Hill College, Mobile, Ala. Here every piece of wood I picked up from the ground, every stump I examined in the large park, was teeming with Termites; they were busily engaged feeding on the dead material which is their staple diet. In spite of being on the lookout for it I did not see any of the live trees attacked by Termites. This confirms my view which is the result of numerous careful observations I made in India and which I have maintained in various papers against contrary assertions: Termites never feed on healthy green plants.

That Reticulitermes is a serious pest in the south appeared clearly from the fact that this species had destroyed large patches of the wooden floors in the lower as well as in the upper stories of what is the Science and Pharmacy Building of Loyola University. Workmen were just repairing the damaged portions of the house which is of rather recent construction. I took a few pieces of the attacked wood, together with some Termite specimens, for my collection.

Nearly twenty years ago I made the statement supported by exact descriptions and photographs: The ''feeding figure'' i. e., the peculiar manner in which Termites bore through wood, is distinct and characteristic for every wood destroyer (Journal Bombay Nat. Hist. Soc. No. 2, vol. xxii, 1913.—See also: Banks, A Revision of the Nearctic Termites. Gov. Print. Off., Washington, 1920, p. 94). Now there is an Indian species, Rectic, indicola, Wasm., related to our American Retic. flavipes. My question, therefore, was: Does the ''feeding figure'' of our species resemble that of the Indian? The relatively few observations I was able to make showed clearly, to my great satisfaction, that both have indeed the same characteristic appearance. This is one more proof that the above mentioned statement, based on Indian Termites, admits of general application.

And now my humble request: If anybody of this same Society finds wood attacked by Termites, let him be kind enough to wrap it in paper and send it to Biology Department, Fordham University. There must, of course, be added a couple of specimens of the Termites that did the damage. To do this, take a small vial, with alcohol, drop the specimens (notably ''soldiers'', those with conspicuous mandibles; also some workers) into it, cork the vial well and send it with the wood. Sincere thanks beforehand. There is still a good deal of work to be done in American Termites. Please help to accomplish it.

CHEMISTRY

THE USE OF POLARIZING MICROSCOPE IN CHEMISTRY

Rev. R. B. Schmitt, S.J.

Chemical microscopy claims recognition because it yields observations which are direct and vivid, conclusions which are more positive and results which are often unobtainable by other methods. Although its methods do not always involve chemical reactions, they do yield chemical information, and they require chemical intuition in their application and interpretation.

A compound microscope equipped with polarizing apparatus has its usefulness extended far beyond that of mere magnification. In addition to its revelation of fine structure, it becomes an instrument for the observation of properties and the determination of constants which are of the utmost significance in chemical investigations and are of wide application in other fields. The polarizing microscope is the instrument for such studies; it takes the place of other less universal apparatus, utilizes easily prepared specimens, and permits easy correlation of form and optical properties.

In practically all investigations of crystalline materials the polarizing microscope is of potential value, and may yield information unobtainable by other means, since it deals with inherent properties as well as with external appearances. Examinations with polarized light do not involve any alteration of the specimen, yet may reveal structural features better than elaborate chemical treatment or staining methods. Animal and textile fibers are all more or less doubly refractive, being essentially oriented aggregates of anisotropic micellae. Not only is the polarizing microscope of value for purposes of identification or differentiation between closely similar fibres, but it also furnishes an excellent method of revealing strains and structural features such as irregular cross-sections, the nodes and dislocations of flax and hemp, or the spiral arrangement of the micellae in cotton and other fibres. Double refraction is particularly significant in the study of natural and artificial fibres of cellulose, for it serves to indicate the treatment they have undergone, and affords a means of following its progress.

The extent and accuracy of the observations made with a polarizing miscroscope depend upon three factors: the knowledge and skill of the observer, the perfection of the apparatus, and the character of the specimen. In no other field of microscopical technique is a thorough comprehension of fundamental optical principles so essential, and "rule of thumb" procedure so likely to lead to error. Simple qualitative observations, intelligently made, are likely to be more useful than elaborate determinations based on half-comprehended directions.

In addition to the usual lens system of objective and eyepiece, polarizing microscopes possess a number of other optical features. It is rarely practical to convert a biological microscope by attaching polarizing apparatus to it; the resulting instrument will only serve for the very simplest observations and will be inadequate for use in most chemical work. The items of equipment which are more or less essential to a polarizing microscope are: polarizer and analyzer; crosshaired eyepiece, fixed so as to indicate orientation of polarizer and analyzer; rotating graduated stage, with provision for adjusting rotation concentric with the centre of the field; compensators, with provision for inserting them in a slot; condenser above the polarizer and a Bertrand lens. If these are not provided, most observations are extremely inconvenient, or even impossible. By passing parallel or slightly oblique rays through a polarizing prism, light vibrating in a single plane is obtained. For illumination the plane or concave mirror may be used; the latter is usually preferable, to concentrate the light and to compensate for the necessary loss of over fifty per cent of its initial intensity within the nicol prism. If a condenser is to be used above the polarizer, to supply convergent polarized light, the cross-section of the prism should be as large as the opening of the lower lens of the condenser, in order to restrict the aperture of the illuminating cone.

The mounting of the polarizer should permit it to be readily removed from the substage, when polarizing light is not required, or if other illuminating apparatus is to be used. It is essential that the nicol prism should be replaceable in a fixed position, so that the plane of vibration of the polarized light from it will be definitely oriented with respect to the microscope. This is made possible by a notch and stud in the mountings.

In addition to form and structure, the optical properties of transparent objects should always be investigated by means of the polarizing microscope. Even in the rare cases where the specimen has no effect on polarized light, this negative information is of value, while in most instances a number of different optical characteristics may be observed and used in identifying the material and in interpreting its structure. In order that such observations may be of the greatest value, a clear understanding of the various phenomena is essential. Certain substances exhibit identical optical properties in all directions, and are spoken of as optically isotropic. No matter what their orientation, they appear to have no effect upon the light which enters them, other than ordinary refraction; and between crossed nicol prisms appear dark, like the field of the microscope, whatever their orientation. Most crystals and many colloidal substances exhibit optical properties in different directions, and are said to show optical anisotropy, double refraction, or birefringence. The chief characteristic of optically anisotropic materials is that they possess not one index of refraction only, as in the case of isotropic substances, but exhibit different indices or refraction depending on the direction of the light passing through them. Optically anisotropic substances possess the property of resolving the vibrations of light which enters them into components which vibrate only in definite, mutually perpendicular planes. These component vibrations travel at different rates, and therefore have different indices of refraction. The mutually perpendicular directions which correspond to the planes of vibration in an anisotropic substance are sometimes called axes of elasticity, or vibration axes.

Application of these optical properties may be made with a great variety of materials. The specific details of the process to which cellulose has been subjected in the manufacture of a given variety of rayon affect its optical character, probably because of a greater or less completeness of orientation of cellulose micellae in the coagulation and spinning operations. Nitrocellulose varies in double refraction, depending upon its degree of nitration. Non-uniformity of nitration, and the presence of ungelatinized fibres in solution can be easily detected. Celluloid, cellophane and cellulose acetate exhibit significant differences depending on their previous treatment. The effect of mercerization of cotton is well defined under the polarizing microscope. The double refraction of collagen fibres in skins is similarly changed by tanning with certain materials but not with others. Starch grains, which exhibit a black cross with polarized light, have been thought to owe their anisotropic character to the concentric layers of isotropic material, but it has been recently shown that they are actually made up of radiating crystals in the form of spherulites. The destruction of the anisotropic character is a very sensitive means of recognizing the gelatinization temperature of the individual grains.

The structure of the cell walls of wood and the arrangement of the micellae in them has been studied with polarized light. Rubber develops optical anisotropy under deformation and loses it on recovery. Gums, natural and synthetic resins, plastics and other similar materials may profitably be examined with the polarizing microscope.

The crystallographic microscope is widely employed in the mineral industries, for examination of raw materials and study of the changes they undergo in the manufacturing operations. The various systems of silicates and aluminates such as are found in portland cement and other ceramic products, the constitution of porcelain, and of refractories, the ingredients and constituents of glass are only a few of its many applications in the general field of ceramics. Pigments and fillers, natural and artificial abrasives, fertilizer ingredients, soil-forming materials, natural deposits and numerous other mineral materials have been studied and described by optical methods.

NOTES

Laboratory Suggestions

Rev. T. Joseph Brown, S.J.

St. Joseph's College Laboratory Manual for the Freshman B. S., and Sophomore A. B., inorganic chemistry classes will be introduced next September. The selecting and compiling of experiments is being done by the Professors of the classes. Several new features are to be introduced. It is hoped that a loose-leaf mimiographed form will supply the need for both classes during the coming scholastic year.

To obviate the continual necessity of rearranging the side-shelf reagent bottles and to give the student a visual aid as a help to return the bottles to their proper places, new sets of colored labels have been printed. Each set of side shelf reagents will have the same colored labels, so the students and instructors can tell at a glance where each bottle belongs.

The use of a small electric floor polisher and parawax continues to be of great assistance in keeping the top wood surface of the laboratory tables in excellent condition. A light coating of parawax is used and with the electric polisher a perfect glossy surface results. Several laboratories are now using this method to preserve the black surface of laboratory tables.

PHYSICS

X-RAYS AND CRYSTAL STRUCTURE

Rev. Henry M. Brock, S.J.

While crystals have doubtless been from the earliest times objects of curiosity and have been sought for in the form of precious stones for purposes of ornamentation, it may be said that crystallography as a science only began in the latter part of the eighteenth century. One of its founders was the Abbe' R. J. Haüy, a French priest. His interest in the subject was aroused by the accidental dropping of a specimen of Iceland Spar. He was impressed by the forms assumed by the fragments. Further study showed him that the figure obtained by splitting any crystal along the lines of cleavage was always the same for the same substance. He measured the angles of many crystals with the goniometer and also laid the foundations of the important law of rational indices.

A crystal in general is a polyhedron bounded by plane surfaces. These surfaces may have different sizes but, if lines be drawn to them from a point within, then the directions of the lines will be fixed and independent of the size or shape of the faces. While a crystal is homogenous throughout, whether it be an element such as a metal, or a compound such as a salt, it is not in general isotropic. Many of its physical properties have values which vary in magnitude with direction. Such are the coefficients of thermal expansion and thermal conductivity, modulus of elasticity, velocity of light, etc. Gravity, as might be expected from its behavior in other respects, is an exception. There is no gravitational anisotropy. This was determined with great precision a few years ago by Dr. P. Heyl at the Bureau of Standards. He could detect no variation in weight with direction.

The characteristic forms and anisotropic properties of crystals point to some regular internal structure, i. e. to a regular arrangement of the atoms or molecules. In a pattern of two dimensions such as a wall paper the units composing it are equally spaced. Corresponding points lie at the intersection of two sets of lines giving a net plane. Extending this to three dimensions in a crystal, we shall have a collection of points formed by the intersection of three sets of planes. Such a series is called a space lattice. It forms the framework upon which the crystal structure is built. It is of interest and importance to learn something about this internal structure. While mineralogy and chemistry have contributed greatly to the development of crystallography, the greatest advances in this direction during the past twenty years have been made with the aid of X-rays. This is because they have made it possible to look into the interior of a crystal and, as it were, see the arrangement of the units of which it is composed, just as they enable us to see in a certain sense the interior of the living body.

As is well-known, the nature of the remarkable rays discovered by Roentgen in 1895 remained a mystery until 1912. A number of physicists supposed they were a species of radiation like light, but of shorter wave length. But against this view was the fact that no diffraction could be produced by a grating. Laue of Munich explained this on the supposition that the wave lengths were so minute compared with those of ordinary light that any possible optical grating would be altogether too coarse. He suggested therefore that the regular arrangement of the atoms in a crystal might be used in its place. If diffraction effects could be obtained with its aid then, given the distance between the atoms, not only could the wave nature of X-rays be established and their wave lengths measured, but the structure of the crystal could also be inferred. The experiment was tried by Friedrich and Knipping. A fine pencil of X-rays was received upon a photographic plate after having passed through a crystal of zinc blende. A long exposure was given and after development it was found that a central spot had been produced in the line of the beam with a series of smaller spots regularly arranged about it. This pattern was evidently caused by diffraction and thus Laue's brilliant surmise was verified.

This experiment opened up a new and fertile field of research. W. H. and W. L. Bragg took up the work in England. They were the first to measure accurately the wave lengths of X-rays. Their values are only about 1/10,000 as large as those of ordinary light. For this purpose and also to study crystal structure they devised a special form of spectrometer. A series of narrow slits in sheet lead served as a collimator since obviously no lens could produce a parallel beam of the rays. A crystal was mounted on a plate in front of the slits and acted as a reflection grating. An ionization chamber on an arm which could be moved over a graduated circle took the place of the telescope. An electrode in the side of the chamber was connected with an electroscope and a potential difference was maintained between it and the wall. To use the instrument, an X-ray beam from a Coolidge tube is passed through the slits of the collimator and reflected from the face of the crystal. The ionization chamber is moved through the paths of the diffraction beams and, when ever one enters it through a slit, the gas within is ionized and the electroscope is charged. An interesting form of this instrument was shown last winter at a public lecture on X-rays at the Mass. Institute of Technology. A small mirror was attached to the arm carrying the ionization chamber. It reflected a beam of light on to a blackboard. The electroscope was replaced by a vacuum tube amplifier connected with a loud speaker. As each diffracted beam entered the chamber it caused a minute ionization current which, when amplified, caused a roar in the loud speaker. The lecturer marked the corresponding positions of the light spot on the board.

The fundamental law of crystal analysis was also derived by the Braggs and it now bears their name. It takes the form $n\lambda = 2d\sin\theta$ where λ is the wave length of the X-ray, d the distance between the reflecting planes, θ the angle of deviation and n the order of the spectrum. They showed that the rays penetrate successive layers of the crystal and after reflection are more or less out of phase causing interference with no resulting diffracted beam. Reinforcement will occur with reflection at angles

$$\theta_1, \theta_2 \cdots, \text{ where } \sin\theta_1 = \frac{\lambda}{2d};\ \sin\theta_2 = \frac{2\lambda}{2d} \cdots .$$

The validity of the method developed by the Braggs, and the correctness of the values of the wave lengths obtained have been confirmed by A. Compton. He was able to diffract X-rays by reflecting them at small glancing angles from an ordinary optical grating.

Other methods have also been devised for investigating crystal structure by means of X-rays. De Broglie modified the Braggs method by using a photograhic plate instead of the ionization chamber and rotating the crystal by means of a motor as the X-ray beam impinged upon it. As each atomic plane comes into position the reflected beam is received upon the plate forming a symmetrical pattern. Debye, Scherrer and Hull reduce the specimen to powder form. The particles will lie at random but, as they are very numerous, there will always be a number in position to make the correct angle with the beam for reflection. The reflected beams take the form of cones which give concentric circles upon the plate.

The Laue method already mentioned is more useful for studying crystal structure than for measuring wave lengths. As the rays are sent through the specimen there is question of a three dimensional grating. The conditions for diffraction are so rigid that for any given wave length it is not likely that any results would be obtained. If however the beam contains a large number of different wave lengths like white light, then there will always be some rays capable of being diffracted and of producing spots on the plate. This was fortunately the case in the Friedrich and Knipping experiment. They used a platinum or tungsten target in their tube, probably the former, which in addition to its characteristic radiation also gives a continuous spectrum over a considerable range. Mention may be made of an interesting modification of the Laue pattern in the case of quartz, recently discovered by Fox and Carr (Phys Rev. June 15th, 1931, p. 1622). They set out to investigate the internal movements of the ions of a quartz plate when vibrating piezo-electrically. As is well-known, such vibrations can be produced by placing the crystal between two metal plates connected with a vacuum tube oscillator.

A Laue pattern was first made with the crystal in the usual way. A very faint effect was obtained after four hours exposure. A similar exposure was then made with the crystal oscillating. A very intense pattern was obtained. No difference was observed when the Bragg method of reflection was employed. (Fox & Cork, Phys. Rev. Oct. 15th, 1931. p. 1420).

X-ray diffraction methods developed by the physicist have proven a powerful tool in solving the mysteries of crystal structure. After Laue the Braggs were the principal pioneers. They showed that apparently the atom and not the molecule is the fundamental unit in a salt crystal. The first crystals which they studied in detail were sodium chloride and potassium chloride. Although these are similar in many respects, their X-ray spectra are different showing a different structure. Since then many other substances have been studied and the work is still going on. Models are now made, and in fact can be purchased, which show the structure of standard crystals. Much skill is however required to interpret the data obtained.

A PRACTICAL NOTE FOR PHYSICS TEACHERS

Walter J. Miller, S.J.

The choice of lecture demonstrations and the preparation of the apparatus in my Physics classes is made much easier by use of the splendid Catalog F issued free by the Central Scientific Company of Chicago, Illinois. It is a handsomely bound volume, 8″x11″, of over 600 pages, fairly crowded with pictures and descriptions of every imaginable piece of apparatus, both classical and modern. The method of operation is explained, the apparatus is illustrated, and, if necessary, diagrams of operation details are added. In the descriptions, the principle is briefly outlined and possible experiments suggested. References are made to all the standard laboratory manuals in use in secular colleges. Since the book is divided into various sections corresponding to the treatises of the Physics textbooks, a glance through the section being treated in lecture almost inevitably suggests possibilities for adaptations of apparatus already on hand.

With the idea of recommending this catalog even to those not in a position as yet to purchase any of the excellent Cenco equipment, I wrote to the Central Scientific Company to find out if the firm is willing to send copies also to those who are likely to specialize in the teaching of

Physics, and I received a very gracious answer giving full permission for this note.

The same recommendation also holds for the Cenco Cumulative Unit System of Laboratory Experiments in Physics, prepared especially for free distribution to college teachers. So far about fifteen important experiments in Mechanics, Heat, Light and Electricity have been issued, all on 8½"x11" paper, and as each new one is completed, it is sent to those on the company's mailing list. Based on simplified and standard apparatus, these pamphlets give detailed descriptions of apparatus recommended, very full discussion of the theory involved, procedure, data and results. Both the Bulletins and the Catalog represent an immense amount of labor, and make available much information that will contribute to the effective teaching of Physics.

SEISMOLOGY

SEISMOLOGICAL PROSPECTING

Rev. George A. O'Donnell, S.J.

Seismology is that branch of Geophysics that treats of earthquakes and earthquake phenomena. Hitherto, it has confined itself mainly to the natural tremors of the earth, but of late years it has focused its attention on the artificial tremors and hence has become one of the recognized modes of prospecting. In this it has met with great success, especially, in locating salt domes in Southwestern United States and in the Gulf Region.

The locating of these salt domes is exceedingly interesting and at the same time extremely important commercially. These domes contain vast amounts of pure salt which in most cases are near enough to the earth's surface to be quite accessible. But, frequently, in addition to the great salt deposits, they are a clue to the presence of oil and sulphur which are found associated with the cap rocks of most of these domes.

These salt structures consist of an anticline with a core of salt. The core is generally circular, looked on from above, and has steep slanting sides and a blunt flat top. The diameters of the cores range from a half to two miles. Usually the top of the dome lies from fifteen to two thousand or more feet below the surface of the earth. These domes are generally surmounted by a cap consisting chiefly of anhydrite, gypsum, and limestone. This cap is a mass of rock like a disk or plate resting on the core and sometimes extending down the sides. It may vary in thickness up to a thousand feet, but generally averages three or four hundred feet. When deposits of oil and sulphur are present, they are usually associated with the cap rocks and porous sands and sandstones which surround them.

There are several theories treating of the origin of these domes, of which the tectonic or salt flowage theory seems to be the most widely accepted. This is based on the hypothesis that the salt was originally deposited in beds and buried deep. Due to the agency of pressure and heat, it became metamorphosed into a semiplastic state and thence by the addition of lateral compression it was forced up through zones of structural weakness into its present state. This theory seems to fit the facts before us.

In locating salt domes, there are two methods which have proven more adaptable to this work and more successful. These are the gravity method and the seismic method. Both of these methods are based on the principle that certain structural formations, subsurface features of the earth's crust, with practically no direct surface expression, possess definite physical properties in themselves or show certain characteristics under the influence of an artificial effect induced in them; and consequently the effect of these properties or characteristics may be perceived by the use of suitable instruments, such as the pendulum, torsion balance or the seismograph.

A brief outline of the gravity methods that have been used may not be out of place. This method is based on the differences of gravity in the earth's crust. We know that the earth's crust is not homogeneous and that there is a variation with the depth. Geological anomalies have been produced by upheavals, structural deformations and the intrusion of heavier materials from below into the lighter unconsolidated sediments above, with the result that the distribution of mass in the earth's crust is very irregular and hence that intensity of gravity varies locally, being greater over masses of greater density and less over those of lesser density. If we were to draw equipotential surfaces of gravity, imaginary surfaces at all points of which the intensity of gravity is the same, we would find them arching up over masses of greater density and curving below those of lower.

The pendulum measures the variation of gravity intensity over a region by the differences in the length of its period at various points in the region. The Period $(T=2_{\pi}\sqrt{\frac{L}{g}})$ varies inversely as the gravity, and the greater the force of gravity, the shorter the period. By taking readings at fairly short intervals of distance, it is possible to plot a curve of intensities, or a gravity curve which gives us the graphical representa tion of the variation of gravity over any distance. Its chief value lies in locating large scale features underground.

The torsion balance measures very accurately the gradient of gravity, i. e. the convergence between two equipotential surfaces, and also the differential curvature of an equipotential surface. The use of this instrument as a guide to the mapping of geologic structure depends upon two assumptions: 1) that the form, depth and relatives density of a mass causing an anomaly in the gradient and curvature can be determined from the distribution of gradient and curvature values in the instrumental registration; and 2) that there is a direct connection between geological structure and anomalous distribution of mass. The truth of these assumptions and their correctness in different localities varies. Consequently the veracity of the interpretation of subsurface structure depends not only on the extent to which these assumptions hold, but also, and perhaps to an even greater extent, on the judgment and skill of the one who operates the instrument and interprets his findings. A body of fairly regular geometrical proportions is most easily defined and directed.

In locating salt domes, the torsion balance is quite efficient since the domes have generally an outline of regular form. The salt domes of the Gulf Coast Region show an excellent concordance of their structure with their gravity effect. This is the reason why the torsion balance has been met with a great deal of success in locating them. However, a topographic correction must usually be made in calculations based on observed data to allow for irregularities on or close to the surface, such as mountain ranges, upland plateaus, large boulders and other such bodies. These often affect the torsion balance as much as irregularities deep down. Hence this instrument gives best results on flat land away from hills, valleys, stream cuts and other surface variances.

The seismic method has been found to be of great utility, especially in regions where the conditions are unfavorable to the operation of the torsion balance—in regions that are hilly or high in relief, or which have too complex local topographic anomalies. The instrument used is the seismograph, an instrument which records the tremors of the earth, both natural and artificial. And in the investigation of salt domes we are interested only in artificial tremors and the kinds of seismographs adapted to record them.

The type of seismograph best adapted for this work is the Schweydar two-component instrument. It has a horizontal and a vertical component and is of the photographic registration type. Its two pendulums are the inverted type, each with a mass of 1800 grams, attached to a Cardanic hinge, or leaf spring, and whose axis of rotation is horizontal for the vertical component and vertical for the horizontal component. There is also in the recording mechanism an electromagnet whose armature controls a small auxiliary mirror which makes a line on the record; this electromagnet is in a circuit so connected with the dynamite charge that at the instant the charge is set off, the circuit is broken. With the circuit broken, the electromagnet becomes dead and the mirror is swung out of line—all this takes place instantaneously. And hence the time of the explosion can be accurately known, since at the moment of explosion the line record breaks off. Other instruments have been used, but all are more or less similar to this Schweydar type.

The general method of seismic prospecting is as follows: a charge of dynamite is planted at some depth, say twenty feet, and is well packed. Seismographs are set up at five or six points whose respective distances differ by several hundred meters, according to the judgment and purpose of the operator. These seismographs may be all located in a straight line with the shot point, or transverse to it, or situated on all sides of it, depending on the situation or the judgment of the one in charge.

The charge is set off and the seismographs write their individual accounts of it. Their records are examined and the time of the first impulse on each record is accurately noted. This is the most essential part of the record, according to the methods now in vogue. A time-distance graph is now drawn, with the intervals between the instant of explosion and that of the first impulse on the seismograms as ordinates, and the distances between the shot point and the respective seismographs as abscissae. Up to a certain distance the first impulse recorded on the seismographs will be the direct or surface wave and will be quite rugged and pronounced. Beyond this point, the seismographs will be found to record a small and almost inconspicuous impulse preceding the heavy surface waves. And the farther out one goes, the greater will be the interval between this small impulse and the heavy surface waves. This small impulse, which eventually precedes the big one, is the indirect wave which darts down from the upper layer of the crust in which the velocity of the wave propagation is low, at what is termed the critical angle, into a lower stratum in which the velocity of wave propagation is higher, and runs parallel to the interface and emerges again at the critical angle to affect the seismograph. This is quite plausible in view of the fact that the indirect wave travels for the greater portion of its path in a medium whose velocity of propagation is much higher than in the surface layer. Thus, the wave that travels over the longer path, arrives first at the seismograph, provided that the seismograph is sufficiently far away.

On the time graph made from the data recorded on the seismograms the curves representing the direct surface waves and the indirect waves are plotted. If a salt dome was encountered by the indirect wave, the slope of the time-distance curve of the indirect wave will decrease at a certain point. This means that the wave traveled farther in less time for part of its path, namely the part of the path that passed through the salt dome. For, we know that impulses will travel must faster through salt than through the other unconsolidated sands, gravels and clays which surround the salt domes of the Gulf Coast. (N. B. The velocity in salt is about 5300 meters per second, while it is only about 2000 meters per second in the sands and clays.) If the impulses of the indirect wave continues through the sands and clays after it has passed through the salt, the original slope of the curve will be resumed. Hence from this graph we can have the position of the salt dome graphically represented. Usually if the presence of a dome is indicated, the seismographs are again orientated around the shot point in a circle of definite radius, and another charge set off. Thus with several seismographs in different positions and a charge set off, the position of the salt dome can be accurately determined. This method, employing the seismographs has been extremely successful in locating salt domes.

The chief value of this seismological prospecting is to discover accurately the structure beneath the surface, when there is little or no evidence on the surface to indicate the underlying structure. Hence they can locate certain subsurface structural formations, salt domes, which are known to be favorable locations for oil deposits. Whether they actually hold oil or not is another question and the answer to that question lies outside the field of the seismograph.

SELENIUM CELL ATTACHMENT FOR PHOTOGRAPHIC RECORDING SEISMOGRAPHS

Rev. John P. Delaney, S.J.

A reliable device that would give a signal in the observatory office when a serious quake is being recorded has been desired by many seismologists. The selenium photo cell has been found adaptable to this purpose at the Canisius College Observatory, Buffalo, after futile experiments had been made with various photoelectric cells and thermocouples. The various hydride cells, the thermocouple and the phototron cells require for their operation more light than is usually employed in the light beam of photographic seismograph recorders, necessitating the use of amplifiers with their several voltages of direct current and the power drain required for continual operation.

The McWilliams Photo Cell No. 4, manufactured by the Electric B.-G. Products Co. of Ithaca, Mich., connected in series with two dry cells and the Weston Galvanometer Relay No. 30, makes a very sensitive and perfectly reliable combination. The galvanometer relay responds whenever the light beam falls on the cell. The cell is mounted about an inch to one side of the center of the cylindrical lens of the recording drum. The galvanometer relay closes a second relay, an old telegraph relay with the spring removed, so that once the circut has been closed this second relay will remain closed until opened manually. The alarm circuit consists of two lamps connected in series, one lamp in the observatory office, and one in the instrument vault. They are small six volt auto lamps supplied by a bell transformer, and the one in the vault is ruby tinted to protect the paper.

In some cases, where an extremely fine light beam is used, it is possible that the light will not suffice to close the galvanometer circuit. Fortunately the selenium cell is more sensitive to yellow and red than is the bromide paper, so that the slit of the lamp can be very much widened or removed entirely and a new slit made with amber or ruby cellophane. The result will be the usual narrow slit of white light with a border on each side of yellow or ruby light to which the paper is insensitive and the cell sensitive. It is a simple matter to adjust such a beam for best results with the paper and cell.

It might be interesting to mention that the same galvanometer may be used for the added purpose of imposing Arlington Time signals on the seismograph record. The selenium alarm circuit utilizes only two of the three relay contacts of the galvanometer. By the use of a double-pole-double-throw switch, the plate current from the Arlington radio receiver may be sent through the galvanometer relay in a reversed direction, and the third relay contact may thus be utilized to close the clock circuit with each impulse from Arlington. It is necessary in this case to employ a suitable shunt across the galvanometer.

The selenium alarm is useful in that it saves several daily inspection trips to the instrument vault with their consequent disturbance to the instruments. It also serves to prevent the hopeless entanglement on seismograms of serious quakes, since the paper can be removed before the long wave and maxima have obliterated the less obvious preliminaries. The train of long waves and maxima can be taken on the centre of a new sheet. Probably the device could be used to great advantage in earthquake regions, where the very first impulse received by a sensitive photographic instrument could be used to set in motion any number of accelerometers or other instruments or safety devices to be called into action on the arrival of a quake.

NOTES

Seismology Department, Manila Observatory, P. I.

REV. WILLIAM C. REPETTI, S.J.

A new 200 kilogram Wiechert Inverted Pendulum was installed at the Baguio Observatory. This takes the place of the Horizontal Pendulums which have been in operation there since 1909. They were not very sensitive and much better results are expected from the Wiechert. Baguio is the only seismic station in the Philippines built on rock and interesting results are expected from a comparison of Baguio and Manila records.

Several changes in the interior arrangement of the space in the astronomical building now permit the removal of the Horizontal Galitzin to the room in which the vertical component is installed. The horizontals have been mounted in the meteorological building and connected to the galvanometers by 300 feet circuits. One of these circuits gave evidence of defective insulation but various tests failed to locate the trouble. The new mounting will eliminate this difficulty.

The typhoon that was of most importance to Manilla this present year passed north in the Pacific east of Manila and then cut across the northeast portion of Luzon. It was characterized by heavy rains. In Manila, in eight days, the precipitation was forty inches and the greater part of this rain fell in three days. The total rain-fall for August was sixty inches. The Manila Railroad had a bridge pier washed out of place and traffic was interrupted for several days; many parts of Manila were badly flooded.

The Philippine Legislature is appropriating 100,000 pesos to begin work on the exhibit for the World's Fair in Chicago 1933.

A typhoon crossed Luzon about 30 miles south of Baguio on November 6th and 7th. The velocity of the wind at Mirador was seventy miles per hour. Another typhoon crossed northern Luzon on the morning of the 10th November, which caused considerable damage in the north. During the typhoon of the 6th the Coast Survey lost three men on the coast of Palawan; they were attempting a landing and the boat capsized.

Father Saderra has suffered a stroke of paralysis, but has recovered sufficiently to act as Director of the Observatory while Father Selga made his retreat. The great need of the Observatory at present is the need of personnel to accomplish the scientific work of the various departments.

Editor's Note: Rev. William C. Repetti, Chief of the Seismic and Magnetic Division of the Manila Observatory, has just published a pamphlet on: "Philippine Earthquake Epicenters (1920 to 1929) North of Latitude 14° 30′. Copies of this Bulletin may be had from the Manila Observatory.

ANNUAL MEETING OF DIRECTORS OF JESUIT SEISMOLOGICAL ASSOCIATION

The regular annual meeting of the Jesuit Seismological Association took place at Loyola University, New Orleans, on December 27, and 28, 1931, anticipating the dates of the American Association for the Advancement of Science meetings, so that the sessions of both organizations might be attended. The members attending were: Rev. George Brunner, S. J., St. Louis University, Missouri; Rev. R. Buckley, S. J., Santa Clara University, California; Rev. J. J. Delaney, S. J., Canisius College, Buffalo, N. Y.; Rev. Joseph Joliat, S. J., St. Louis University, Missouri; Rev. Joseph Lynch, S. J., Fordham University, N. Y.; Rev. James B. Macelwane, S. J., St. Louis University, Missouri, and the Rev. John S. O'Conor, S. J., Georgetown University, Washington, D. C. Occasional meetings were also attended by Fr. Francis, of Loyola, New Orleans, who acted as host to the members of the Association, and Fr. Kolkmyer, S. J. of Georgetown, and Mr. Dahm, of St. Louis.

While abstracts of the papers presented may appear later, the program of the meeting is subjoined. The paper of Messrs. Kelly and O'Flaherty, was read by title. Advance sheets of a table including new values for distances corresponding to S-P differences for earthquakes of normal depth were distributed to all the members. It was also tentatively decided to hold the next meeting in the spring of 1933, at Cincinnati, Ohio.

Program of papers: "The Ohio Earthquake of September 20, 1931." Rev. J. S. Joliat and G. J. Brunner; "Automatic Registering of Arlington

Time Signals at Buffalo", Rev. J. P. Delaney; "Recent Instrumental Developments for Recording Earth Motions in Terms of their Accelerations", Rev. J. S. O'Conor; Grid Biasing in Relay Recording", Rev. J. J. Kelly and Mr. V. O'Flaherty; "A New Table of Distances and Travel Times of Earthquakes", Rev. J. B. Macelwane; "Some Characteristics of Deep-Focus Earthquakes", Rev. J. S. Joliat; "Construction of a Small Shaking Table Capable of Superimposing Two Simple Harmonic Motions" and "A Practical Working Model of a Seismograph", Rev. J. Lynch.

Round Table Discussion: "The Elastic Rebound Theory of Earthquakes."

SEISMOLOGICAL NOTES
FORDHAM UNIVERSITY

REV. J. JOSEPH LYNCH, S.J.

A working model of a seismograph has been developed for exhibition at the Chicago World Fair. It is a horizontal pendulum mounted to record mechanically on waxed paper. Pressing a button starts a small motor which drives the recording drum and a few seconds later sets the support in vibration. The vibrations come in three groups with periods approximating the P S and L waves. The motor stops after the three groups have been recorded visibly on the waxed paper so that for each pressing of the button a complete artificial quake is produced and recorded before the observer. A special model will be built in the shop of the field Museum of Chicago and put on exhibition at the Fair under the name of "Fordham University". At the close of the Fair, it will be put on permanent exhibition in the Field Museum. Our own model was taken to the New Orleans Meeting and exhibited in the Municipal Auditorium. About 20,000 viewed the exhibit.

A new short period Wood Anderson has just been received and will be set up with a Galitzin Recorder. If the combination works, a second component will be installed immediately.

RECENT BOOKS

The books mentioned in this column are recommended by our Science Professors as suitable for the Science Libraries.

BIOLOGY

Snakes of the World, Ditmars.
The Macmillan Co., New York.

Chemical Embryology, Needham.
The Macmillan Co., New York.

A Textbook of Neuro-Anatomy, Kuntz.
Lea & Febiger, Philadelphia, Pa.

Textbook of Embryology, Mary T. Harmon.
Lea & Febiger, Philadelphia, Pa.

Textbook of Histology, Piette.
F. A. Davis Co., Philadelphia, Pa.

CHEMISTRY

Recent Advances in Organic Chemistry, Sixth Edition,
By Alfred W. Stewart. Longmans, Green & Co., N. Y.

Physical Chemistry. Elementary Text for Biological and Premedical Students. By Louis Gillespie. McGraw, Hill Book Co., New York.

Photochemistry, by D. W. G. Style.
E. P. Dutton & Co., New York.

Nucleic Acids, by P. A. Levene & L. W. Bass.
The Chemical Catalog Co., Inc., New York.

Elements of General Chemistry, by J. A. Babor, W. L. Estabrooke and A. Lehrman. Thomas Y. Crowell Co., New York.

Laboratory Manual in Elements of General Chemistry, by J. A. Babor, W. L. Estabrooke and A. Lehrman. Thomas Y. Crowell & Co., New York.

Potentiometric Titrations, Second Edition, by I. M. Kolthoff and N. H. Furman. John Wiley & Sons, Inc., New York.

Laboratory Exercises and Problems in General Chemistry.
By B. Smith Hopkins and H. A. Neville. D. C. Heath & Co., N. Y.

Examination of Water, Chemical and Bacteriological, Sixth Edition.
By W. P. Mason. John Wiley & Sons, Inc., New York.

PHYSICS

Photoelectric Phenomena, by Hughes and Dubridge.
McGraw, Hill Book Co., New York.

Snow Crystals, by Wilson A. Bentley.
McGraw, Hill Book Co., New York.

Advanced Electrical Measurements, by Smythe & Michels.
Van Nostrand Co., Inc., New York.

Introductory Acoustics, by G. W. Stewart.
Van Nostrand Co., Inc., New York.

Applied Gyrodynamics, by Ervin S. Ferry.
John Wiley & Sons, New York.

An Introduction to Physical Geology, by W. J. Miller.
Van Nostrand Co., Inc., New York.

SEISMOLOGY

An Introduction to Theoretical Seismology.
By Frederick W. Sohon, S.J. John Wiley & Sons, Inc., New York.

BOOK REVIEWS

"AN INTRODUCTION TO THEORETICAL SEISMOLOGY PART II, SEISMOMETRY"

BY REV. F. W. SOHON, S.J.

(John Wiley and Sons, 158 Pages, $2.75)

Seismology might be said to have come "of age" in the United States, as twenty-one years ago the first seismograph was installed at Georgetown University.

This event is suitably commemorated by the appearance of a volume entitled: "An Introduction to Theoretical Seismology; Part II, Seismometry", by Rev. F. W. Sohon, S.J., of the Georgetown Observatory.

The purpose of the work is well summed up in the preface where Fr. Sohon says: "It is hoped that the book will enable the observer (of earthquakes) to understand the principles which underlie his instrument, and that he may be enabled to test it, keep it in adjustment, understand its shortcomings, and give an intelligent account of its behavior."

The book begins with a fundamental discussion of oscillatory motion, an essential prerequisite for seismometry, and then passes on to a general treatment of the two main classes of instruments; those that register the horizontal, and those that register the vertical motion of the earth respectively.

The recording mechanism is then described. This chapter tends rather to the practical side of the question.

There follows a very adequate treatise on first the static, and then the dynamic magnification of seismographs. The integration of the indicator equation, the discussion of the behavior of the "U function" of Galitzin, the response of the instruments to various periods and the analysis of phase differences are all taken up and developed with a conciseness that the seismologist has sought for in vain in the mass of periodical literature that has appeared from time to time.

The effect of friction is treated in chapter seven, its application being, of course to the machines using the mechanical type of registration.

But the observer operating Galitzin instruments will find chapters eight and ten most valuable. Herein Galvanometric registration is taken up, (Chapter 8) and a greatly simplified method of the determination of constants is evolved, (Chapter 10). Chapter nine deals with what might be called the "pons asinorum" of the instrumental seismologist; the reduction of preliminaries, wherein the exponential term of the indicator equation must be included, and where simple harmonic motion can not be assumed, except as an approximation.

Having had occasion to use part of this work in manuscript form, the writer of this review is convinced that as well as in the matter of practical technique, as in the amount of computation involved, the "Tapping Test" of Chapter ten, if carefully followed, would result not only in the saving of time, but also in the dissipation of the notion that the difficulties in Galitzin calibration are not worth the efforts necessary to produce results of questionable accuracy.

If the book leads to a facilitation of constants determination that results in the standardization of all our Galitzin instruments it will more than have served the purpose of its publication.

The volume also contains an appendix which treats of the solution of four seismological problems by graphical methods.

J. S. O'C., S. J.

ELEMENTS OF GENERAL CHEMISTRY.

JOSEPH A. BABOR, Assistant Professor of Chemistry; WILLIAM L. ESTABROOKE, Associate Professor of Chemistry; and ALEXANDER LEHRMAN, Instructor of Chemistry; all of the College of the City of New York. Thomas Y. Crowell Co., New York City, 1931. x + 601 pp. 134 Figs. 21.5 x 14 cm. $3.75.

This is primarily a textbook for students who have had no previous course in chemistry. An excellent foundation in basic principles is offered in the first half of the book, and is intended to fit the student either for further study in the subject or for intelligent and profitable pursuit of a pandemic course. The book is in no way designated as a pandemic text; but the author states that the arrangement permits, at midyear, the division of classes according to whether or not they intend to go further in chemistry.

The order of presentation of material does not differ widely from the conventional arrangement of topics. A unique and pleasing feature is the early and extensive treatment of atomic structure, with thereafter frequent use of the concepts to explain chemical behavior. The author employs both cubical and "ring" diagrams to represent atoms; however, the student's attention is directed to the fact that neither diagram is an actual picture of the atom. The use of "plus and minus valence" in connection with the balancing of oxidation-reduction equations is open to question, as it may create an erroneous impression regarding the nature of the linkage in non-polar compounds. A novel feature, but one that seems to be justified, is the grouping of two such apparently unrelated subjects as chlorine and sodium hydroxide. The study of metallic elements begins with iron and is followed by the platinum group, a deviation from the usual topical arrangement which has our hearty approval. The relegation of the chapters an organic chemistry to the end of the text is amply justified, and permits the student to attain sufficient background to appreciate the nature of that field.

There is a certain amount of similarity, as is to be expected, between Babor's more advanced text and the present book, with its more detailed discussion of theoretical material and the presentation of a greater number of illustrations for the benefit of the beginner. The theoretical sections, although well done, may make the text a little too heavy for use in a course of limited class time. The concept of pH is in our opinion of little value to beginners, as is also the detailed description of methods for the determination of molecular weights.

The subject matter of the earlier chapters contains nothing which we feel should be omitted from a course in elementary chemistry. In the second half there are certain chapters and more or less fine print, which may be omitted without handicapping the student. The arrangement of the text is such as to permit certain omissions without detracting from its usefulness. Although the text is the joint work of three, the style is very smooth. We do feel, however, that in places the direct influence of certain contemporary texts is evident.

The exercises at the end of each chapter are well chosen and should afford a good review of the contents of the text. The book is adequately illustrated, and explanatory figures appear where they are of value. We feel that this text is a distinct contribution to its intended field.

E. B. K.

PHYSICAL CHEMISTRY. AN ELEMENTARY TEST PRIMARILY FOR BIOLOGICAL AND PREMEDICAL STUDENTS.

Louis J. Gillespie, Ph. D., Professor of Physical Chemical Research, Massachusetts Institute of Technology, Formerly Fellow Rockefeller Institute of Medical Research, then Bio-chemist of the United States Department of Agriculture. McGraw-Hill Book Co., Inc., New York City, 1931. vx + 287 pp. 43 Figs. 13.5 x 20.5 cm. $2.75.

This book is especially intended to be of service to those students who are pursuing premedical or biological courses. The book contains twenty-eight chapters, discussing the principal topics found in the general text books on physical chemistry. It is of significance, however, that the author has omitted a chapter on colloids and includes the physical properties of colloids in several of the other chapters. Among the chapters, the subject matter of which is treated at length and special applications made to the biological science, are the chapters on "Cells for the Determination of Hydrogen-Ion Concentration of Activity", "Buffers and Titration Curves", "Indicators", and "Donnan Equilibrium". Throughout the text the author has made an effort to apply physical chemistry to the problems of biology. The author has adopted a research point of view which is helpful to the student in applying physical chemistry as a valuable tool in carrying out biological investigations.

In the chapter on surface tension, it is regretted that the author does not make mention of the relation of surface tension in the modern theory of cell antisepsis. In the same chapter mention is made of the fact that sodium salts form oil-in-water emulsions and calcium salts favor the formation of water-in-oil emulsions. The antagonism of sodium and calcium in biology is pointed out. It should be mentioned, however, that this antagonism of inverting emulsions is not a specificity of the calcium ion but the same condition would obtain with magnesium and other divalent ions. Reference to Harkin's theory of orientation would aid the students in understanding the phenomenon of emulsions and emultion reversibility. The reviewer feels that the matter of buffer capacity is not treated at as great a length as it should be in a treatise of this kind. Its many references to biology, both in the plant and animal kingdom, are neglected. In the mind of the reviewer the paragraph on errors tolerated in the calculation of pH would be made plainer to the student if a table showing the relationship between hydrogen-ion concentration and pH were included. Furthermore, it might be advantageous to emphasize that a difference in pH units in the neutral region of the pH scale is of less significance than the same numerical change on the extreme acid side of the scale. Often times this fact is difficult for students to grasp.

The author fulfils his purpose in writing this book, that is, to present a practical working text in physical chemistry for students of biology. His style is precise and direct, and the student is not inundated by the mathematics presented by the author.

J. C. K.

TEXTBOOK OF EMBRYOLOGY,

By Mary T. Harmon,

Published by Lea & Febiger, Philadelphia, Pa.

It is a book of 475 pages and is well arranged. The cuts are splendid and abundant. Many of the cuts from other books have been used, so that the book combines the author's own work and that of the well-known embryologists of the present day. The book is well adapted to a college course in human embryology and covers the early stages of the amphioxus, frog, bird and mammal. There is an appendix containing a short laboratory outline which is too brief for our course. There is also included in the appendix the technique for the preparation of embryological material.

TEXTBOOK OF HISTOLOGY.

F. A. Davis Co., Philadelphia, Pa.

This book is one of the best that have appeared in the last ten years. The illustrations are excellent. They are perfectly clear and are well selected. The text has important topics and structures in heavy type which makes it easy to review a subject or locate some particular point to be studied.

NEWS ITEMS

FORDHAM UNIVERSITY. SEISMOLOGY DEPARTMENT

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES

January 4, 1932.

Office of the Local Chairman
Tulane University
New Orleans, La.

Rev. J. J. Lynch, S.J.
Fordham University
Fordham, N. Y.
Dear Sir:

As Chairman of the Local Committee and in behalf of Tulane University and the City of New Orleans, I wish to express my very great appreciation for the splendid exhibit your university put on in connection with the recent meeting of the American Association for the Advancement of Science in New Orleans. It was estimated by those in charge that between 15,000 and 20,000 people enjoyed your exhibit described in the accompanying folder.

We of New Orleans and Tulane feel that you have helped to sensitize our community to the achievements and potentialities of science, and it is our opinion that you have rendered a splendid service to science as well as reflected great credit on your own institution.

Again expressing our great appreciation for your assistance, I am

Very truly yours,

D. S. Elliott,
Chairman of the Local Committee.

FORDHAM UNIVERSITY. Chemistry Department. The Chemists' Club issued the third number of "The Retort", a new chemical magazine which had its first publication last October. It is edited by a staff of undergraduates in the chemistry department, under the direction of Dr. Walter A. Hynes, Professor of Qualitative Analysis.

At the bi-monthly meetings of the Chemists' Club, a student gives a lecture on some topic which he investigated. Typical subjects: Hydrogenation of Oils; Tests with Dimethylglyoxime; Molecular Weights by Steam Distillation; Reactions of Diphenylcarbazide.

Seminars for the graduate students are held every Saturday; Dr. Sherwin is in charge of Physiological Chemistry and Dr. Cerecedro conducts the Organic Seminar. About once a month both groups attend a joint seminar to discuss a common subject.

Several seminars will be devoted to the works of Nobel Prize Winners in Organic Chemistry from 1901 to 1931. Occasionally a chemist from the industries is asked to address the groups.

The Chemistry Library is constantly growing. At present there are seven hundred volumes in the graduate department, and about five hundred in the undergraduate department. Many new foreign and American text books were added recently.

BOSTON COLLEGE. Chemistry Department. Two interesting and informative talks were presented by Rev. Dr. Joseph J. Sullivan, S.J., Head of the Chemistry Department, over the Yankee Network. The subjects of the talks were: "The Air We Breathe", and "The Water We Drink." The first was delivered December 24th, and the second Decembr 31st. These weekly talks in chemistry over the air are sponsored by the Northeastern Section of the American Chemical Society. Each paper is printed and copies may be had by writing to the Yankee Network.

A paper on modern synthetic organic medicinals was presented by Salvatore P. Palmieri, M. S., '32, for the first chemistry seminar for 1932.

WOODSTOCK COLLEGE: Dr. Karl Herzfeld of Johns Hopkins University lectured before the Psychology class and a large part of the community. His subject was Scholastic Philosophy and Modern Physics. A paper on Television will be read at the coming philosophy disputation by Mr. E. L. McDevitt. The Woodstock Seismological Observatory is now in operation. Continuous recording was begun on Christmas day, 1931. A good clock was donated by the Seismological Department of Georgetown University. Two philosophers are assisting in the work of the new observatory.

Special Notice: Anyone desiring cultures of the following species and mutant forms of Drosophila may obtain them by writing to Mr. Harley: Wild-type cultures of D. melanogaster, D. funebris and D. busckii. The following mutant forms of D. melanogaster: curly, spineless, white, white-mineature, vermilion, attached-X, brown-vestigial, attached-x-brown-vestigial, garnet-forked-bar, vestigial.

LOYOLA COLLEGE, Baltimore, Md. Chemistry Department. On December 15, Dr. Herbert Insley, of the Bureau of Standards, Washington, D. C., gave a lecture to the members of the Chemists' Club; his subject:

"Finger Prints of Crystals". The lecture was illustrated with Micro slides projected with a polarizing microscope. The first lecture in January was delivered by Dr. William Schroeder, Jr., Sanitation Commissioner of New York City. He gave a most interesting and instructive discourse on the topic: "Chemistry of Municipal Sanitation."

CANISIUS COLLEGE. Biology Department. During the second semester a new course is to be introduced in "Biology and Evolution". The lecture schedule in this course will be so arranged as to make it available for regular college and extension students who have already completed the necessary requirements in biology. A minimum of one year's work in general biology will be a pre-requisite. The course will be conducted by George A. Wahl, M. A.

It is expected that thirty five students in the regular college will register for the course in Vertebrate Embryology. This increased registration may entail a re-arrangement of laboratory schedules. Incidentally we have decided to introduce as a laboratory manual in this subject Wieman and Weichert's "Laboratory Manual for Vertebrate Embryology". To those interested this little manual will repay inspection. It contains instructions for the preparation as well as for the inspection and study of whole mounts and serial sections of the chick and pig and follows the progressive method of study through the 96 hour chick to continue with the 10 mm. pig.

ST. PETER'S COLLEGE. Biology Department. On December 7th Father Freatman, Professor of Biology, broadcast over station WHOM of Jersey City on the topic: "Psychology of Birds" or "Do Birds Think?" He treated in a concise manner all the principal arguments for and against intelligence in birds. He proved the lack of intelligence from examples of personal observations.

ST. JOSEPH'S COLLEGE. Biology Department. A Postgraduate Student who is majoring in Chemistry is taking Biology as a minor. As he has completed the courses in Embryology, Histology, Neurology, and Osteology given in the B. S. course, he is studying Myology. An embalmed monkey was secured and has proved a splendid specimen for dissection. It has been found that in a number of instances contiguous muscles which have a separate insertion in the human are inserted by a common tendon in the monkey.

WESTON COLLEGE. Physics Department. The altitude above Mean Sea Level was determined in the following way: The nearest Coast and Geodetic Survey bench mark was about six miles away, so a nearer mark was sought. It was found on the Boston and Maine Railroad: Blk. Signal No. 160, top of Bolt—N. E. corner of base: 184.53 feet above

M. S. L. This signal was only two miles from the College. Using the third step, north corner, of the Philosophers' entrance as a starting point the level was run. This point was found to be 40.389 feet above the Railroad mark or 224.92 feet above M. S. L. In running the level back from the Railroad mark to the original starting point the altitude was found to be 40.391. This check showed a difference of only 0.002 ft. Then a level was run through the building to the top of the Physics lecture-table; this point is 233.54 feet above M. S. L. A brass plate was installed in the Physics Lecture-hall, five feet above the floor, with the elevation carefully marked.

SHANGHAI, CHINA. Zikawei Observatory. Father E. de la Villemarque was promoted to the directorship of the Zo-Se Observatory at Zikawei, Shanghai. He replaces Father L. Gauchet.

ROME, ITALY. Vatican Observatory. Father Raimondo Puigrefagut of the Province of Aragon was named assistant to Father Stein. Father Puigrefagut just completed his tertianship.