A. M. D G.

BULLETIN

of the

American Association of Jesuit Scientists

(Eastern Section)

(For private circulation)

GEORGETOWN UNIVERSITY
WASHINGTON, D. C.

Vol. VI No. 1

A. M. D G.

BULLETIN

of the

American Association of Jesuit Scientists

(Eastern Section)

(For private circulation)

GEORGETOWN UNIVERSITY
WASHINGTON, D. C.

Vol. VI No. 1

A. M. D. G.

BULLETIN

of the

American Association of Jesuit Scientists

(Eastern Section)

VOL. VI. No. 1. JANUARY, 1929

CONTENTS.

On September 12, 1928, the Rev. Edward C. Phillips, S.J., President of the American Association of Jesuit Scientists (Eastern Section) and Director of the Georgetown University Astronomical Observatory, was installed as Provincial of the Maryland-New York Province. Pleased as we were to have Fr. Phillips as Provincial, we cannot but deplore the fact that the Observatory has lost a very able Director and the Association a most capable President.

THE ATENEO MUSEUM

The Museum, Ateneo de Manila, is unique. It presents Filipino life in all its phases. The flora, the fauna, the arts and industries, the intellectual life of the people, all find satisfying expression in this complete collection garnered into one great hall and inviting the visitor by its very accessibility. Bizarre forms stand out in the long range of Phyla both native and exotic. One may see the Scaly Anteater, the grotesque miniature primates hailing from Leyte and Samar, the weird Flying Lemur and the monster Sea Turtle drawn from the waters of Manila Bay. In fact turn where you may in this Museum made forever venerable in the eyes of patriotic Filipinos by the schoolboy labors of their great compatriot Dr. Rizal, the eye is caught by some object of more than ordinary interest.

This truly remarkable collection made its beginning in the year 1865 when Fr. Pedro Bertran, S.J., was Rector of the College. Fr. Jose Minoves, S.J., as the first Curator actually initiated the great work of gathering specimens from all parts of the Archipelago. In this he was materially aided by the Jesuit Fathers stationed in Mindanao and by the students of the College amongst whose numbers were representatives from practically every province of the Philippines. From small beginnings the collection gradually increased by the efforts of devoted Curators until it assumed its present imposing form, safely housed from dust and destroying molds in great wall cases of glass and molave. Two names stand out on the roster of those who so unselfishly labored for the benefit of generations of students to come: the beloved Fr. Francisco de Paul Sanchez, S.J., raised by the Municipal Council to the dignity of "Son of the City of Manila," teacher of the great Rizal and for more than twenty years the guiding genius that collected and classified and who but recently passed away at the advanced age of 78 years; and the scholarly Fr. Juan B. Solá, S.J., whose handbook on the plants, minerals and animals of the Philippines is such an excellent aid to the student of Natural History, and who succeeded Father Sanchez in the administration of the Museum. Father Solá continued in his office until Ateneo passed from the hands of the Spanish to those of the American Jesuits. To these three Fathers and to their co-workers, biologists in the Philippines owe an immense debt of gratitude. The practical acknowledgment of their accomplishment lies in the great numbers of students who yearly come to learn from actual specimens, the fauna of their country. Year after year students of Systematic Biology at the University of the Philippines and other leading institutions come to supplement their courses, while frequently experts from the Bureau of Science call for purposes of comparison or observation. It may be said in passing that any individual with serious intent will gladly be afforded any or all of the Museum's facilities. This has ever been the policy of the Curators.

The Zöological Catalogue of the Museum is comprehensive. It embraces all the phyla from Chordates down through the Metazoa to the Protozoa—the latter being represented by the siliceous skeletons of the Foraminifera.

Worthy of special note is the collection of shells valued at approximately twenty thousand pesos. It comprises specimens of all land, river and sea shells to be found in the Islands. The Birds form the next largest zöological unit. Among these the great Monkey-eating Eagle is supreme, while the Hawks and Sea Birds invite close attention. The Timarao, match for the most daring Nimrod and representative of the day when primitive conditions were the rule, but now forced back into the mountains of Mindoro, is a striking figure among the Mammals. Vieing with him in interest is the set of huge Whale bones flanked by a brace of man-eating Sharks captured near Malabon by the nets of Sr. Processo Gabriel. The Dolphins famed in mythological lore and the blunt-nosed Dugong or Sea-cow are objects to rouse the memory to childhood's readings of far away, unknown seas. The Ray with its flattened diamond of a body and long death-dealing sting hints of the fate lurking for the unwary diver in Southern waters. Cotabato offers its attraction in the form of the gigantic Crocodile that stretches across the main floor of the Museum; while Boas between twenty and thirty feet in length, suspended along the galleries, bring to a focus the dangers of Tropical Forests. The Ostrich and the Cassowary complete the tale of strange and interesting forms to be seen by those who would but avail themselves of the opportunity any Thursday or Sunday morning.

One side of the lengthy galleries give a complete display of Moro arms, clothing and utensils. Here, too, may be seen the handicraft of the Mandayas and Manobos.

The Kris, the Battle-axe, the Cannon of brass and the Armor together with the barbed Lance of the Moro and the musical instruments of the more primitive tribes of Mindanao, the gaudy hued garments of Moro, man and child, with the beaded clothing of his women, present a graphic picture of war and romance in the island empire to the South. The huge Rice Dish, a single piece of Narra, fully five and one-half feet in diameter, personifies the village gatherings in times of rejoicing.

The serious student of Philology is attracted by the ancient manuscripts written in a script of bygone days. These together with a miscellaneous collection of models and works by Filipino artisans complete the background to the picture of life in our sea-girt Islands.

An excellent Herbarium offers opportunities to the Botanist.

A more detailed account of Ateneo's Museum would serve only to weary the general reader. The more obvious and striking details of this truly magnificent collection alone have been noted. May these lines written in a spirit of gratitude to the Spanish Jesuits who so clearly realized the value of just such a collection and who worked so generously and unselfishly to attain their ideal, serve as a spur to the youth of the Philippine Islands to appreciate and to profit by the untiring labors of men possessed of a true, scientific instinct.

F. X. Reardon, S.J.,
Woodstock College,
Woodstock, Md.

COOPERATION OF THE SOCIETY OF JESUS WITH SEISMOLOGICAL STUDIES

By Rev. Manuel Sanchez-Navarro, S.J.

Synopsized and translated by B. F. Doucette, S.J.

Note. Under this title Fr. Sanchez has published considerable detailed information about the personnel and equipment of Jesuit seismological stations. A reprint of his articles, printed in *Iberica,* a Spanish scientific periodical, was loaned to the editor through the kindness of Fr. Tondorf. As the accounts of the various stations are quite long, it was thought best to synopsize the article. After an introduction in which the importance of seismology among other studies of natural phenomena is developed and the location of the various stations explained for the benefit of the readers of *Iberica,* Fr. Sanchez gives individual accounts of the various stations, beginning with Manila Observatory.

MANILA. Soon after the establishment of the Manila Observatory (1865), Fr. Juan Ricart set up two instruments for determining the direction and amplitude of horizontal and vertical movements. Records were kept with few interruptions and new instruments added as the science developed. Among the older instruments, one designed by Fr. Renkin, S.J., is worthy of mention because of the ingenuity displayed. The present equipment consists principally of a Wiechert astatic inverted pendulum, registering the two horizontal components, with a mass of 1000 kgms., and a magnification of about 200 with a period of six seconds. The data collected by the department of the observatory are published in a special bulletin. Fr. Miguel Saderra-Maos, S.J., is in charge of this department and has contributed many interesting books and articles about seismic phenomena in the archipelago. At present *Fr. W. C. Repetti, S.J., is completing his studies under Fr. J. B. Macelwane, S.J., in preparation for future work at the Manila Observatory.

---

*Father Repetti is now in the Philippines.

RIVERVIEW. At the famous College of St. Ignatius at Riverview near Sydney, Australia, there has existed since 1909 a very important seismological station founded by Fr. Edward F. Pigot, S.J. In a partly subterrenean vault, two Wiecherts, one of 1000 kgms., the other of 80 kgms., are installed. Besides there are two bifilar Mainka pendulums for registering vertical movements with mass of 450 kgms., and of the "ante bellum" type. Also there is a complete group (two horizontal components and the vertical) of the Galitzin magnetic-photographic registration. It is to be regretted that the poor health of Fr. Pigot has prevented the required adjustments to the vertical-component pendulum, which has not given entire satisfaction. Fr. Pigot received his seismological training partly at Zi-ka-wei, Shanghai, and partly at Apia, where he worked with two pupils of Dr. Emilo Wiechert.

KSARA. The history of this scientific center contains many sorrowful incidents. Destroyed during the World War, it has been restored in spite of much opposition, due to the watchfulness and constancy of its learned and energetic founder, Fr. Buenaventura Berloty, S.J. Established in 1907 the observatory of Ksara now consists of astronomical, meteorological, magnetic and seismological departments together with a geodetic station of the first class. Its director is the official head of the meteorological service for Syria and Lebanon and he belongs to the Academy of French Sciences. Many munificient donations have enabled him to rebuild the observatory.

The first seismographs, which were two Mainka instruments, mass 135 kgms., suffered during the war and have disappeared. At present the installation consists of two Mainka seismographs, 450 kgms. mass, built according to a French model, a terrestrial globe for rapid determination of epicenters, an excellent wireless set with an "electrogeno group" given by the geographic department of the French army and equipment consisting of a meridian circle, an astrolab for precise determinaton of time, so necessary where seismographs are installed.

The members of the staff at Ksara are Fr. Berloty, Fr.

Charles Combies and Fr. George Horan, all of the Society of Jesus.

Data obtained from the seismographs concerning the more important earthquakes are telegraphed to the central international office at Estrasburgo and also published, with other information about smaller earthquakes, in a special bulletin. The main purpose of the observatory is meteorological, magnetic and map-making work, yet, amid the duties connected with these departments, advantage is taken of the favorable situation in Asia Minor, Armenia and Persia where earthquakes are frequent.

ZI-KA-WEI. Near Shanghai, China, in a suburb named Zi-ka-wei, in remembrance of a great mandarin, Paul Zi, who was the first of these powerful rulers to embrace the Catholic faith, is the meteorological and seismic observatory of that name. Connected with it at Lukiapang is a magnetic station.

At this observatory, in the midst of other occupations such as determining the paths of typhoons, Fr. Ernest Gherzi, S.J., has investigated many phenomena of seismology with the excellent instruments under his care. In recognition of his work, Fr. Gherzi has received two excellent Omori seismographs from the Emperor of Japan, who has also given decorations to Fr. Gauthier of the observatory for his scientific services.

The instruments at the observatory consist of an inverted Wiechert pendulum of 1200 kgm. mass, purchased in 1909, and a vertical component pendulum of 80 kgm. mass, purchased in 1924, besides the two Omori pendulums mentioned above. The most valuable apparatus, however, is a Galitzin vertical component pendulum made by Hugo Masing in 1915 at St. Petersburg (as the city was then called).

Fr. Gherzi has two Chinese assistants who do very creditable work in interpreting the data and preparing it for publication in the bulletin of the observatory. Fr. Gherzi, too, is the author of many valuable contributions to the science, one of which is the substitution of the letters "c" and "d" for the plus sign and minus sign, respectively, in seismological bulletins.

TANANARIVE. This observatory, situated in Madagascar, upon the hill of Ambohidempona, 1400 meters altitude, has a history similar to that of Ksara. The installation of a Bertelli seismograph in 1927 promises excellent results because of the favorable situation of the observatory with regard to earthquakes in the Indian Ocean, as well as more distant shocks in Africa and Europe. The remaining apparatus, received in 1926, consist of two Mainka pendulums, of French style, mass of 450 kgm. each, and a Leroy "electric pendulum" fitted with a bar of invar, for time signals. These have been installed in a recently excavated chamber in solid rock, making a fine shelter when the storms of that region approach.

The present director, Fr. Charles Poisson, S.J., has seen service in the French navy during the war and was decorated for his bravery. His education has very well prepared him for directorship of an observatory where meteorological, magnetic and seismological work is carried on. On occasion, he is able to cooperate with astronomical observations, but his principal duty is the forecasting of cyclones, and an excellent wireless station has been installed there for the communication of such forecasts and the other communications necessary for their preparation.

UNITED STATES. Under the title, Jesuit Seismological Association, a scientific corporation has been formed with central offices at St. Louis, Missouri. Stations contributing data to the central office receive recognition for their services, thus retaining the individuality of the stations. An annual meeting of all the directors of the various stations is another feature of the association.

The formation of this association was encouraged by the Carnegie Institution, the United States Coast and Geodetic Survey and Science Service. The association has as its president Fr. James MacElwane, S.J., who received his degree at the University of California. A few of the stations will be briefly described.

FLORRISSANT. The central station of the association is situated on the novitiate grounds at Florrissant, a few miles from St. Louis. The apparatus is in an underground chamber and consists of an 80 kgm. Weichert, a complete group of Wood-Anderson seismographs and a complete group of Galitzin magnetic-photographic seismographs. The Wood-Anderson recording mechanism is the result of a year of very patient research and has a very uniform rate of 60 mm. per minute. The Galitzin seismographs were constructed by Hugo Masing, who was once under Galitzin, and by J. Wilip, who was the director of the seismic station at Pulkova and now professor at the University of Tartu, Estonia. This collection of apparatus is due to a donation of fifteen thousand dollars from Major Martin Connolly of Washington.

Fr. MacElwane is well known through his publications on mathematical seismology. His intended project of uniting the J. S. A. with Hawaii and Manila by wireless so that data from these stations could be utilized promptly would make a magnificent chain of stations for this important study.

In Florrissant the seismographs are housed in a location where uniform temperature is maintained, and being 27 miles from the city, it is free from extraneous vibrations. All the above mentioned instruments except the Weichert seismograph, which is at St. Louis, are installed at Florrissant.

GEORGETOWN. This station at present contains many seismographs of varied sensitivity and magnification. There is a Weichert seismograph of 200 kgm. mass for the horizontal components and one of 80 kgm. mass for the vertical component. Two Omori-Bosch instruments of 25 kgm. mass, a Mainka of 133 kgm., a pair of Bosch instruments with photographic recording, one of which has a period of 5 sec. and magnification of 120 times, with a rate of 15 mm. a minute, form part of the equipment. Then there is a Galitzin instrument for the vertical component, constructed at Cambridge, England, and a pair of the same type for the horizontal components constructed by the same firm, all of which have added to the prestige of Fr. Tondorf, who has charge of the seismographs at this university. Fr. Tondorf is the author of many interesting articles presented to scientific gatherings and societies in the United States. He has collaborated in studies on the "loitering agitations" with the railroad engineer, Mr. Stuart B. Moore. His "Seismological Dispatches," in addition to his bulletins, gives valuable service to other stations.

CINCINNATI. In the Jesuit College of St. Xavier, there are intsalled five Wood-Anderson instruments and a Galitzin-Wilip for the vertical component.

FORDHAM. This station was made possible through the gift of Mr. W. Spain of New York, who wished to present a memorial in honor of his son, an alumnus of Fordham who died in the World War. The apparatus consists of two Milne-Shaw seismographs, and there is hope of obtaining a complete group of Galitzin seismographs in the near future.

HAVANA. The Observatory of Belen, of world-wide fame, due to the study of cyclones in the Antilles on the part of Fr. Benito Vines, S.J., and his successors, Fr. Gangoiti, S.J., and Fr. Gutierrez Lanza, S.J., possesses at Luyano, three kilometers from the college buildings, a seismological station inaugurated February 3, 1907. The equipment consists of two Omori-Bosch pendulums, each of 25 kgm. mass, for the horizontal components. No reports, either directly from the observatory or indirectly by quotation in seismological bulletins, have been received at this station. If the station has not continued to function, it is regrettable because of the favorable location of the observatory in the midst of the West Indies, where epicenters of some important earthquakes have been located.

Fr. Gutierrez Lanza has contributed at Havana and in Santiago, Chili, various articles, much praised by eminent seismologists, among whom is the founder of the seismological Geography, the Count Montessus de Ballore.

LA PAZ, BOLIVIA. Founded by Brother Stephen Tortosa, S.J., this station, installed in the Colegio de San Calixto a bifilar pendulum, a copy of the one which Brother Tortosa cared for in Cartuja, Granada, before going to Boliva. Besides, thanks to the installation of Fr. Peter M. Descotes, S.J., this station is considered to have the best equipment of any station in South America, and its publications are frequently quoted. This is more remarkable when one considers the fact that the instruments were constructed at the station itself. They consist of a vertical pendulum, mass of 1500 kgm., 2.5 seconds period, and a magnification of 1100 times in its two components. A bifilar pendulum N-S component, mass 2000 kgm., 14 second period and 180 times magnification, together with another of the same style, E-W component, 3500 kgm. mass, 12 second period and 300 times magnification (due to some modifications), were added later. Both of the latter instruments have damping.

Fr. Descotes, the director, is chief of the seismological service in Bolivia. In connection with the latter office, he has charge of a powerful wireless station, a gift of the French government, a splendid telescope, made by Cook, with an objective 102 mm. (4.01 in.) in diameter, various chronometers, and, above all, a fundamental pendulum made by Leroy. This, together with the seismographs, are installed in the cellar of the church, where they are free from changes of temperature and extraneous vibrations. Fr. Descotes has been honored by the French government for his scientific services and he has taken part in important scientific conventions in Europe.

SUCRE. This station was founded by Fr. Descotes as an auxiliary station to that at La Paz. It has a bifilar pendulum, E-W component, of 3000 kgm. mass, 12 second period and magnification 300 times, and a vertical pendulum, N-S component, is to be installed later. A good Troughton telescope, a Dent siderial chronometer, two Leroy pendulums, complete the equipment. Fr. Francis Carro, S.J., is in charge of the station.

BOGOTA, COLOMBIA. In the observatory of the Colegio de San Bartolome of Colombia, under the direction of Fr. Simon Sarasola, S.J., a Cartuja bifilar seismograph of 300 kgm. mass is mounted, the product of the "Automatic" laboratories under the direction of the eminent inventor, Torres Quevedo. This seismograph recorded very well until local irregularities required its dismantling, and thus far it has not been assembled. Fr. Simon Sarasola is planning a seismic station in keeping with the standard of his observatory.

STONYHURST. In this famous college is an observatory with astronomical, magnetic and meteorological departments which have been under the care of an uninterrupted series of directors having high scientific caliber and initiative. Seismology has occupied a secondary place, a fact which, however, does not detract from the bulletins published there. A photographic Milne-Shaw pendulum, of the same type as that at Fordham University, N. Y., constitutes the equipment.

TORTOSA, Ebro Observatory. The seismographs at this famous observatory, where seismology has been of importance since its establishment, are due to the mechanical skill of Brother Narcissus Hornos, S.J., who has charge of the workshops there. Fr. Ignatius Puig, S.J., the sub-director, has published a fine article in Razon y Fe (vol. 75, page 518, 1926) concerning the activities of the observatory. From this article, the following information concerning the equipment are taken: The principal seismograph is a Mainka horizontal pendulum, N-S component, mass of 1500 kgm., magnification 200 times, which instrument is suitable for distant earthquakes. Another of the same style, but only 150 kgm. mass and magnification of 50 times, is used for the E-W component. The third seismograph is a vertical pendulum, 300 kgm. mass, with magnification 100 times, N-S component is suitable for local earthquakes. The fourth seismograph is a Vicentini vertical pendulum of 100 kgm. mass, magnification 75 times, and serves for the E-W component for local shocks. The fifth seismograph of the same style (Vicentini) is a rigid and elastir bar supporting a mass of 50 kgm., and suspended horizontally to record vertical movements.

GRANADA. The seismological station of Cartuja, Granada, whose observations began to be published in January, 1903, functions entirely independent of the observatory of the same name. This arrangement began in 1908, when it was transferred with the Collegium Maximum of the Society to the suburbs of Granada. There, the present location, about 400 meters from the first temporary installation, shelters a pair of Cartuja bifilar pendulums with a mass of 340 kgm. each, together with a Cartuja vertical pendulum, 280 kgm. mass, with a period of 2 seconds and a magnification of 200 times, all of which were built in the workshop of the station.

In a room of the college and mounted on pillars separated from the floor, are the Javier horizontal pendulum of magnetic-photographic registration, E-W component; the Bellarmine vertical component pendulum of the asymmetric Galitzin type, somewhat modified, together with the recorders, lights, galvanometers and such; and lastly the Berchmans inverted pendulums, of the Weichert style, but with numerous variations. The last mentioned is of 3000 kgm. mass, 5 second period, magnification 600-750 times, and designed for the study of weak local shocks. Other instruments are under construction and still others being planned. A better location, larger and less subject to temperature change, is being sought for.

Those in charge of this station, besides caring for its regular monthly bulletins, have charge of the seismological department of Iberica, and have taken part in many conventions, as well as given numerous lectures before universities and military academies. Their work has helped very much in educating the public concerning seismology.

B. R. Doucette, S.J.

AN AURORA BOREALIS AT KEYSER ISLAND

An added attraction of the teachers' villa at Keyser Island this summer was a beautiful display of Northern Lights which occurred on the night of July 7. While it was not a very active display as regards swiftness of motion of the lights, it was notable on account of the large extent of sky covered by the lights. At about 9:45, daylight savings time, I happened to notice a brilliant arch across the *southern* sky. At first I was inclined to attribute it to a layer of cirrus clouds at high altitude. But soon the fact it was symmetrical with the meridian and that Saturn seemed to be visible through it, with no apparent loss of brilliancy, led me to suspect that it was the auroral arch. The suspicion was verified a few minutes later, when the whole sky became ablaze with streamers converging to a point about fifteen degrees *south* of the zenith, at which point there was a solid mass of light. The color was the ordinary greenish-gray, except to the eastward, where the streamers were of a fairly reddish hue. This phase lasted about half an hour.

At about 10:10, the arch to the south (which had an altitude of only 28 degrees above the southern horizon, since Saturn, at declination plus 21 degrees, was in the center of the arch) disappeared, to return about ten minutes later about 10 degrees higher in the sky. It disappeared and reappeared several times at short intervals.

By 11 o'clock, everything had receded north of the zenith, and at this time it resembled the ordinary displays, consisting of curtains of light, slowly shifting about, and at times almost entirely disappearing.

When I next looked at the sky, at 11:45, the whole sky was ablaze again in practically the same formations that had existed earlier in the evening. This lasted for about fifteen minutes, at the end of which time everything disappeared except the quadrant to the southwest, which took on a deep red to purple hue, especially near the radiant, or point of convergence. Soon afterwards, however, everything disappeared except a few streamers, which were pulsating along their length.

The next morning I looked at the sun's image formed by projection from a small pair of field glasses, and noticed two fairly large spots near the eastern limb of the sun. The glasses were not sufficiently powerful to give either good definition or good magnification.

THOMAS D. BARRY, S.J.,
Weston College, Weston, Mass.

THE EGGS OF ASCARIS MEGALOCEPHALUS

All of the biologists are familiar with what excellent material the eggs of ascaris are for showing the successive stages of fertilization, maturation, etc., of the egg. I think I spoke to the biologists at one of our meetings of the usefulness of slides which I obtained from one of the technicians at the University of Pennsylvania. I am not an agent for the slides, but would like to see our laboratories supplied with a set of them. Since the ascaris megalocephalus has but four chromosomes, the material is wonderfully suited for study. These slides are so prepared that successive longitudinal sections of the uterus or egg tube show the various stages to be studied. The distal end of the uterus being the last reached by the spermatozoa, shows them free in the uterus, while some are seen just entering the egg, others immediately after entrance, etc. In this particular section the eggs have not developed a shell. There are four or five sections of the tube on each slide, and the student by passing from one section to another can see every stage from the entrance of the spermatozoon through the discharge of the polar bodies, fusion of the male and female pronuclei and the early cleavages up to the eight or sixteen-cell stage. Similar slides are advertised by some of the supply houses, but only one or two stages are to be found on a slide and the charge for each slide is $1.50 at least, while the U. of P. slides show all of the stages on one slide and sell for $2.00 apiece.

Boston College, Loyola College, Baltimore, and St. Joseph's College, Philadelphia, are supplied with them, and if any of our biologists wish to obtain the same kind they may order them from Dr. E. E. Carothers, Department of Zoology, University of Pennsylvania, Philadelphia, Pa.

C. E. SHAFFREY, S.J.,
St. Joseph's College, Philadelphia, Pa.

"FOUR OUT OF FIVE HAVE IT"

Practical application of our chemistry and biology are of general interest and add to the life of the subject in the classroom. Were these the only reasons we should welcome a brief survey on the subject of Pyorrhea. How graphically and terribly it has been portrayed in the high-powered, artistic productions of the advertising columns of newspapers and magazines we well know. "The Danger Line" and the famous catch expression that is our title are daily before our eyes.

There is, however, another aspect—a more scientific one—that has its interest to the teacher of science and in the classroom, and we can point out to our students the methods of research and the orderly, observant clinical work that are being joined together by the dental profession in order to trace out a solution of this widespread disease. This article will present to teachers some of the examples of careful and systematic study that show, in the concrete, a model of approach to a problem, and another lesson to our classes that knowledge is not luck and that study, in order to be fruitful, must be well planned, serious and constant.

Dental research in pyorrhea began at the zero mark, not only in lack of knowledge, but also in lack of hope of accomplishment. Here was a universal and apparently incurable disease. The bony socket into which a tooth is set disintegrates, the thin layer of mucous membrane which forms the gum gradually becomes an inflamed, diseased, bleeding surface, the strong intertwined fibres and ligaments passing from the walls of the bony socket to the tooth loosen and slough away, pus pockets form below the gum line, and the only relief—for there was no cure—was obtained by a moment's work with the extracting forceps.

The situation called for study in the histology, physiology, chemistry, pathology and bacteriology of the normal and abnormal region. Extending the proper approach to the work adequately, the investigators found it necessary to know the relation of local functions and disturbances to those of the system as a whole. Let us see some of the questions that face the investigators. What is the exact normal microscopic structure of the hard and soft tissues affected by this disease? What bacteria are present? Are they the cause of or merely concomitant with the condition? Would vaccines or antitoxins give us a solution to the difficulty? What causes the deposit of calculus, and this only an after effect? Is this deposit due to calcium precipitating bacteria? How can the design of instruments be improved for complete removal of this foreign matter? Does the saliva undergo chemical changes that would indicate anything in connection with the disease? What about mineral metabolism? What about nutrition? What about endocrines, What would be the right composition of medical solutions as an aid?

These questions indicate scores of others that their answers will raise and show how complex is the subject. Nevertheless, the workers have patiently pursued their task. The results appear from time to time in the Journal of the American Dental Association, the Dental Cosmos, and the Journal of Dental Research. Various local dental societies and societies of dental research (of which latter the profession has a number) have taken up a share of the work. Dental schools and infirmaries such as the Forsyth in Boston and the Eastman in Rochester have carried on investigations and the Carnegie Foundation has advanced financial support through some of these organizations.

What success has been attained? To this question no final answer can yet be given. Medical and dental men never use the word "cure" with the freedom of some of the manufacturers of medicines and dentifrices. Experience that goes back to their days in medical and dental school has taught them prudence in that respect.

Some success, however, has rewarded the efforts of the workers. It was formerly believed that while it was possible to arrest the progress of loss of tissue, it was out of the question to hope for the growth of new cells to replace it. Treated sections of the jaw, which for other reasons had to be removed, have been carefully saved, prepared and sectioned for X-ray and microscopic study, and convincing evidence has now been found of reattachment. The X-ray has also shown the fillingin of bone in situ after treatment despite considerable loss around the root of the tooth. But the professional and scientific caution in regard to the word "cure" is still necessary, since the exact relationship between this growth and treatment has not been ascertained. In some cases there seems to be no connection. To the biologist it is interesting to note that the growth of new bone cells in the tooth socket left the bone in better physiological condition, but the crest of the socket did not grow back to its original higher level. Thus the old problem remains: can we get the bone cells to grow back around the tooth all the way up to its normal level, or will it, at best, merely remain at its new level and only thus far be stimulated to replace old cells with new?

The local bacterial problem has been studied and not only the kinds but also their number has been noted. Data concerning the relative decrease of number and kind following treatment has been collected and it was found that it varies with spiral rods, large rods and micrococci. The significance of this is not known, but perhaps the more resistant ones are more pathogenic. Some years ago the dental profession seemed to have "struck oil" with the apparent success of vaccine treatment. It was only temporary and was given up. Later, however, the conclusion has been arrived at that the vaccines need not be entirely abandoned and it may prove an important aid. We are certain that pus-forming bacteria must be gotten rid of, and it is more likely that the right vaccine has not been made and that its composition must vary in different cases. Furthermore, the calculus precipitating bacteria may succumb to a yet undiscovered vaccine. The bacteriologist, therefore, keeping in mind something that will be death to germs and yet in no way injurious to weakened tissue and new growing cells, has his part to play.

Biochemistry requires attention in the problem. Nutrition and its relation to the weakening and loss of tissue is evidently a field of study and considerable work has been done. The relation of diet to saliva and its organic and inorganic composition, mineral metabolism and vitamin intake, with its effect on these affected tissues, have made up an important part of the investigation. As an example of this, bone cell deficiency in the jaws has been produced in animals by defective nutrition in the research laboratory at the Forsyth Dental Infirmary, Boston, Mass., an institution endowed with over a million dollars for research, as well as clinical work.

Animal experimentation has been and will be necessary. The investigators endeavor to reproduce in dogs, rabbits and guinea pigs pyorrheal conditions by injections from the human disease. The progress of destruction and repair by comparison with excised human tissue can be carried on for further result.

A final field of investigation will be that of endocrinology. For instance, the known relation of the thyroid gland and the control of calcium metabolism will shed light on bone and tooth development. The effects produced in the growth of the jaws by changes in the pituitary gland will be traced out. Thus the ductless glands will yet unfold the mystery of their influence in the progress of loss and repair.

From this general view, the teacher of chemistry and biology can readily see that to the dentist and research man pyorrhea is something more than a matter of recommending a toothpaste. The student of these sciences, and in particular those who are preparing for medicine or dentistry, can understand that when he can follow a like method in approaching a problem he is gaining the wisdom that true science teaches.

VINCENT A. GOOKIN, S.J.,
Weston College, Weston, Mass.

QUANTITATIVE METHODS I

The Determination of Silicon and Phosphorus in Iron (Modified Method of Blair)

Dissolve 1 gram of the iron drillings in a 250cc beaker in 25cc of nitric acid (sp. gr. 1.135), with the addition of a little hydrochloric acid. Evaporate to dryness, redissolve in hydrochloric acid, evaporate to dryness and heat for half an hour on the hot plate at a temperature at least 200° C. Redissolve in 10cc hydrochloric acid (sp. gr. 1.19), dilute, filter and wash. Receive the filtrate in a 400cc beaker and evaporate to syrupy consistency. Ignite the filter paper containing the insoluble matter, burn off the graphite and weigh. Treat the material in the crucible with hydrofluoric acid, and a few drops of sulphuric acid, evaporate to dryness, ignite and weigh. The loss of weight is silica, which multiplied by 0.4693 gives the amount of silicon.

Dissolve the residue in the crucible in hydrochloric acid and add it to the solution in the beaker. Add 25cc nitric acid to the syrupy solution in the beaker and boil down to a few cc, avoiding spattering. Add 25cc more of the nitric acid and boil again to decompose all the hydrochloric acid. Transfer the solution to a 250cc Erlenmeyer flask, using about 20cc of water and 75cc of nitric acid (sp. gr. 1.135) for washing out the beaker.

Place the flask in a vessel of cold water, or allow it to stand in the air until it feels cool to the hand, and then pour in 40cc of dilute ammonia (sp. gr. 0.96). The precipitated ferric hydroxide will dissolve when the liquid is thoroughly mixed. Add 5cc of a saturated solution of ferrous ammonium sulphate and one drop of a strong ammonium bisulphite solution which reduces the vanadium to the vanadyl condition which does not interfere with the precipitation of the ammonium phosphomolybdate. When the solution is about 40° C., add 40cc of molybdate solution at the ordinary temperature, close the flask with a well fitting solid rubber stopper, and shake for 5 minutes. Allow the precipitate to settle, filter on a perforated porcelain crucible with well constructed asbestos felt, wash several times with 2 per cent nitric acid solution till free from iron and then twice with 95 per cent alcohol. Dry at a temperature of 110° C. for half an hour and weigh.

The weight of the precipitate multiplied by 0.0163 (empirical factor) gives the percentage of phosphorus.

N. B.—Evaporate off as much of the strong nitric acid as possible before adding the 75cc of nitric acid (1.135).

If the yellow precipitate does not come down promptly, the solution may be warmed somewhat; but on no account should the temperature of 60° C be exceeded.

Rev. R. B. Schmidt, S.J.,
Loyola College, Baltimore, Md.

THE EARLY HISTORY OF THE DECIMAL POINT

The American Mathematical Monthly for August-September, 1928, carries an interesting article under the above title. As this Journal is not available to many of our teachers, it may be interesting to quote the following from this paper.

The purpose of this paper is to call attention to a fact which seems to have been overlooked by all historians, namely, that the credit of being the first to use a dot (point) as a separatrix, with full knowledge of its significance in this connection, is due the Jesuit Father Christopher Clavius (1537-1612). In his work on the astrolabe, published in Rome in 1593, he gives (pp. 195-270) a "Tabula Sinuum," where the proportional parts are separated from the integers by periods (points, dots). So far as now known, this is the first appearance of the decimal point in a work in which its full significance is given. The table antedates the Pitiscus edition of 1608, which has been so carefully studied by Prof. Cajori. It also antedates Napier's *Rhabdologia* (1617), Wright's translation of the *Mirifici logarithmorum canonis descriptio* (1616), and Kepler's *Ausszug auss der uralten Messe-Kunst Archimedis* (1616), in each of which the decimal point or comma is used. As to Buergi's use of the symbol in a manuscript of 1592, the claim is no longer seriously considered. The name Stevin, who wrote the first book upon the decimal fractions, need not to be considered in this connection, since he made no use of the symbolism under discussion.

It remains to consider whether Clavius understood the significance of the symbol, for otherwise he would be entitled to little more credit than Pellos, who, in 1492, wrote 5383694.3 as the quotient of 53836943 by 10, but showed no further appreciation of decimals. That Clavius actually did understand its significance appears by the following from statement on page 228:

* * * quoniam inter duos sinus grad. 16 min. 12 grad. 16 min. 13 positi sunt duo binumeri 46.5 colligemus uni secundo inter minutum 12 13 gradus 16 congrue particulas $46\frac{5}{10}$, ex

differentio 2793 inter duos sinus 2789911, 2792704 praedictorum arcuum grad. 16 min. 12 et grad. 16 min. 13 qua tota differentia secundia 60, hoc est. It amounts to the following: In the table on p. 198 of the work of Clavius referred to on p. 198, the number 46.5 is put between sin 16°12′ and 16°13′. Hence to every second (of the difference) between 16°12′ and 16°13′ we will apportion $46\frac{5}{10}$ particles of the difference (2793) between 2789911 (sin 16°12′) and 2792794 (sin 16°13′), etc.

It would seem, therefore, that up to the present time the evidence is conclusive that Clavius was the first to use the decimal point with a clear understanding of its significance. This does not, of course, invalidate the positive evidence that the decimal fraction was used with other symbols before the time of Clavius.

Francis A. Tondorf, S.J.,
Georgetown University, Washington, D. C.

THE PHYSICS LABORATORY IN OPERATION AT GEORGETOWN

The three weeks of systematizing classes are over, and the student of Physics is about to begin experiments. To have any success, at least three requisites must obtain. The first is a clear, discriminating, laboratory manual; the second is a laboratory, in which any student would take pride in doing his work; the third is the able and prudent direction of capable instructors. That the first requisite is excellently fulfilled in the concise and clear Georgetown laboratory book, any one who has used a variety of manuals will enthusiastically admit. It is the regret of the present writer that such a supplement has not even been given a chance in some of our colleges and houses of study, and this despite our incessant cries for Jesuit textbooks in our scientific departments.

We have postulated as the second requisite a laboratory, in which the student will take pride. Due to the plan of construction of the Healy building, Georgetown possesses two spacious Physics laboratories. This very accidental division, we believe an advantage, for we are thus enabled to equally apportion our classes, on an average of seventy men, between the two laboratries. A number greater than thirty-five simultaneously in a laboratory would present many obvious difficulties.

A laboratory, to encourage industrious effort, must be well-equipped, well-lighted, and, above all, thoroughly clean. That the Georgetown laboratory amply satisfies these conditions is attested to by the instructors, the students and our visiting scientists. A few descriptive details may suggest the truth of our assertion. Our Laboratory "B" is about 90 by 35 feet. The nine tables, about 11 by 5 feet, are placed parallel to each other. Above each table are the A.C. and D.C. lines, as well as the gas outlet. Running water, hot and cold, may be had at the farther end of the laboratory. The tables are finished with a black, acid-proof paint and oil, and are kept constantly polished by our industrious workman. A like arrangement obtains in the "A" laboratory, which is 60 by 45 feet, except that here the tables are smaller, so that two may extend the width of the room.

There are six rows of tables, 7 by 3 and 13 by 3 feet, respectively, and on the sides of every table the positions are numbered in aluminum paint.

All our instruments, when not in use, are kept in large showcases, ever ready for the student's inspection, but not for his too-often careless handling. The order of instruments proper to the various branches of Physics, namely, Mechanics, Heat, Sound, Light and Electricity, is observed in the respective showcases, which by reason of their proximity to the laboratory tables, spare the assistants many inconveniences, and stimulate in the student a beneficial curiosity.

The first day in the laboratory means for the Georgetown student the reading of the "riot act" and the performance of a comparatively easy experiment. The student is told that at his entrance into the laboratory he is to proceed to the anteroom, there deposit his clothing, and all books, save his laboratory pad and manual. Thence he is to go to the bulletin board, where his experiment for the day may be checked up, and his experiment for the coming week may be learned. From that day forward he is to come to the laboratory with such a knowledge of his work to be done that in the event of all the manuals being collected, he may, without hesitation, proceed with his experiment. That such knowledge is essential to laboratory work has been impressed on the student by the actual collection of the manuals. The student now proceeds with his work, and should the assignment involve any special difficulties, the director spends about five minutes in explaining the essentials.

Laboratory is a class period, and all unnecessary talking will not be tolerated. According to the judgment of the laboratory director, or the variety of the instruments, the students may or may not work in pairs, though the former is more often the actual case. Each student is told to write in his pad all his observations and to make a carbon copy. The assistants, three in each laboratory, are kept busy correcting errors or giving help, where the student evidently cannot help himself. It is the chief duty of every assistant to satisfy himself that the student has grasped the experiment in hand. For example, when the experiment of the Vernier is given, no student is permitted to leave the laboratory until he has acquired a facility in determining the least count of any vernier whatsoever.

At the end of the experiment, the student submits his observations to the instructor, who carefully examines them, having regard for the expression of units, e.g., 6.542cm., and not 6.542; for uniformity in tabulations, e.g., 0.542g., and in general for whatever might hinder confusion, when the student transfers his observations and makes his calculations. The director then affixes his signature, the papers, pencil and carbon copies are stamped as due the following week, and the carbons are placed on file, while the student retains the originals. Should the student complete his experiment before the allotted hour and a half, he is told to remain and work out his calculations. Before he leaves his position, every student is required to arrange his apparatus in exactly the same condition as it was prior to his work. The training that is thus acquired in neatness and sense of responsibility cannot be overestimated.

Special sheets of paper for the final write-up are sold to the students. They are 17 by 10 inches and fold in the middle. On the first page is printed the name of the student, the date and number of the experiment. The remainder of the page is given for the theory and the apparatus. On the left side of the inner page the student is to write the procedure in his own words, and on the right the observations and calculations are to be set down neatly and clearly. On the last page of the sheet are tabulated the results, the measure of accuracy, or the percentage of error, and the possible sources of error. A week from the day on which the experiment is performed, the special report is to be handed in, with the original papers enclosed. These experiments are inspected as soon as possible, errors indicated, and are stamped: "To Be Corrected," "Accepted," or "Rewrite." If this first or last obtain, the experiment is returned, the revision to be made within a week and in red ink or pencil. If the experiments are accepted, they are filed away until the end of the year, and go to make up the credits necessary for the various degrees. We might here fittingly discuss the system employed at Georgetown in assigning experiments throughout the entire year, a difficult task, as all who have had experience will admit, but we trust our co-physicists throughout the Province will supplement our remarks in this respect in the forthcoming issues of The Bulletin.

George P. McGowan, S.J.,
Georgetown University, Washington, D. C.

OUR PRESENT KNOWLEDGE OF HEREDITY AND ITS RELATION TO EVOLUTION

The science of heredity or genetics is inseparably connected with the evolution question. If evolution of any kind whatever has taken place, it must have been through changes which were inherited. The findings of heredity must therefore have a direct bearing on the evolution question and no theory of evolution can be true that does not square with the known facts of heredity. The purpose of this paper is to sum up briefly our present knowledge of heredity and to inquire into its relation to the evolution question.

Briefly put, the facts of this discussion are as follows: the hereditary characters of an organism are supposed with very good reason to have their material basis in small bodies called chromosomes found in the nucleus of the cell. In a species of nematode worm, Ancyrocanthus, the number of chromosomes can be counted in the living germ cell. The number, size and shape of the chromosomes differs for different species of organisms, but are constant for any one species. Most organisms begin their life as a single cell formed by the union of a female germ cell, the ovum, and a male germ cell, the sperm. Consequently there must be something in this single cell, the fertilized ovum, that has the power of producing all the hereditary characters that will cause the new organism to resemble its parents and the species to which they belong. This something is thought with good evidence to be chromosomes. Every time a cell divides in the growth of an organism, each chromosome splits longitudinally into two equal parts, so that the two cells formed have the same number of kind of chromosomes as their parent cell. There is one exception to this rule, however, and this takes place during the formation of germ cells. When egg and sperm cells are ripening, or, as it is technically termed, undergoing their maturation divisions, there occurs one division in which the chromosomes do not divide into two parts, but half of the entire number of chromosomes are distributed whole to each of the daughter cells. This division is called the reduction division, since by it the number of chromosomes is reduced by one-half. As a result of this reduction division ripe germ cells, whether egg or sperm, have but half the species number of chromosomes, or have as it is called the haploid number. Consequently, when fertilization takes place, a sperm with the haploid number of chromosomes unites with an ovum which also has the haploid number and forms a fertilized ovum with the full species number of chromosomes. A new organism is eventually formed from this fertilized ovum by a series of normal mitotic cell divisions in which each chromosome splits into equal halves at each division.

The reduction division is then the single exception to the general method of cell division and must serve some important purpose, which is thought to be the preservation of the characteristics of the species by the preservation in the new organism of the species number of chromosomes. These facts and theories of heredity have been derived from cytology. An entirely different line of discoveries have been derived from the science of experimental breeding, and these facts coincide remarkably with the findings of cytology.

The experimental method of attacking the problem of heredity was first successfully used by Bregor Mendel. The chief reason for the success of his breeding experiments are two; first, he did not try as did his predecessors to observe all the characters by which hybrids differed from their parents, but restricted himself to one character at a time. Secondly, he reduced the possibility of experimental error by choosing for the subject of his experiments a species of plant having varieties differing from one another by well-defined and easily recognizable contrasted characters; for example, tall peas 6 feet in height and dwarf peas 1½ feet in height. Furthermore, he selected a species that was normally self-fertilized, but easily capable of artificial cross fertilization. I will describe briefly the simplest of Mendel's experiments.

Mendel selected a tall and a dwarf variety of the common garden pea and crossed them. The results of this cross or the first filial or F 1 generation, as it is called, were all tall peas. The individuals of this F 1 generation were all self-fertilized and the resulting or F 2 generation was found to consist of tall and dwarf peas in the proportion 3:1. This F 2 generation was again self-fertilized and the following results obtained: the dwarfs yielded nothing but dwarfs, one-third of the talls yielded nothing but talls, and the other two-thirds of the talls yielded talls and dwarfs in the proportion 3:1. The dwarfs yielding all dwarfs Mendel called pure dwarfs, the talls that yielded only talls he called pure talls, and the talls that gave both talls and dwarfs he called impure talls. Carrying the experiment through further generations gave the same results, dwarfs giving nothing but dwarfs, pure talls giving nothing but pure talls, and impure talls giving talls and dwarfs in the usual mendellian proportion, 3:1. As a result of these and many other experiments, Mendel formulated his famous principle of Segregation, or, as it is called, "the purity of the germ plasm." This principle states that when the factors for two contrasted characters meet in an hybrid they do not mix and give us an intermediate result, but remain distinct and are segregated or sorted out so that when the hybrid is self-fertilized some of both parental forms return and breed true.

The explanation of the above result is as follows: every individual pea plant began its existence by the union of two germ cells, a male and a female gamete. These germ cells must contain the factors, or, as they are now called, the genes which will bring about the development of each character in the individual. In starting his experiments, Mendel chose pure tall peas, that is, talls that always bred true, and pure dwarfs; consequently the germ cells or gametes of the pure talls all had a factor or gene for tallness and the dwarfs likewise produced gametes all of which had a factor for dwarfness. When these two parent types were crossed they gave rise to the F 1 generation of hybrids, all of which must have had one factor for tallness and one for dwarfness, and were therefore all impure with respect to the character of height. Since all the individuals of the F 1 generation were tall, in spite of the fact that each also had a factor for dwarfness, Mendel called tallness the dominant factor and dwarfness the recessive. All the plants of this impure F 1 generation produced male and female gametes, some of which had the factor for tallness, others for dwarfness; consequently, when they were self-fertilized, four possible combinations resulted:

a T male gamete might unite with a T fem. gamete, giving a pure T;

A T male gamete might unite with a D fem. gamete, giving an impure T;

a D male gamete might unite with a T fem. gamete, giving an impure T;

a D male gamete might unite with a D fem. gamete, giving a pure D.

Since these four combinations happen by chance, they will occur in about equal numbers. Since tallness is dominant and dwarfness recessive, the two impure talls will be indistinguishable from the pure talls, and hence we should expect in the F 2 generation the proportion 3T :1D, which is precisely what was found by experiment. We also see that the 3 :1 ratio is really a 1 :2 :1 ratio, 1 pure tall : 2 impure talls : 1 pure dwarf. In succeeding generations the pure talls will always yield pure talls when self-fertilized, since they have no factor for dwarfness. The pure dwarfs will always yield pure dwarfs for the same reason, and the impure talls will yield talls and dwarfs in the mendellian proportion, 3 :1.

This simple experiment of Mendel's has been repeated in many species of plants and animals. The method of experimental breeding has been developed to a high degree of efficiency, and many cases that at first appeared at variance with mendelism have been found to be in perfect accord. The literature on the subject is voluminous, and the evidence it contains when compared with the findings of cytological investigation renders highly probable the theory that it is in the chromosomes that the genes or factors for the various characters are contained. Another development of mendelism is the phenomenon of linkage. In many cases the number of chromosomes is small, while the number of genes is always relatively large; hence many genes must be in each chromosome. Morgan of Columbia has good evidence to show that in the case of species of fruit fly he has not only determined which genes are in each chromosome, but also that he has mapped out the linear position of some of them in their respective chromosomes.

If the genes for two different characters, such as height and color of seed coat, are linked, that is, are in the same chromosome, then these characters are normally inherited together, and the experimental formula found on breeding them differs from the formula for two characters that are in different chromosomes, the case originally studied by Mendel. The phenomenon of linkage would be relatively simple if linkage were absolute, i.e., if the genes in a given chromosome always remained in that chromosome. This, however, is not so, and in about 9 per cent of these cases a phenomenon modifying linkage takes place, called crossing over. Briefly, this phenomenon and its theoretical explanation are as follows: just before the reduction division in the maturation of germ cells, the pairs of chromosomes come together in what is termed pseudo-reduction. In this state the individuals of a pair frequently not only lie close together, but twine around each other, and when they come to separate in the real reduction division it is thought that they frequently do not untwine, but separate in such a way that corresponding parts of the chromosome become interchanged. The fact of crossing over is well established experimentally, but its explanation by the twisting of chromosomes is purely theoretical, although this much may be said in its favor, that it is the only explanation of crossing over that remains plausible and in some cases the twisting of chromosomes has been observed by cytological investigation. Linkage appears to be absolute in the male, i.e., these cases of crossing over appear to occur only in female germ cells.

Sex also seems to be determined by certain chromosomes called sex or X chromosomes. Females sometimes have two X chromosomes and males one X chromosome; hence after maturation all the female germ cells will have one X chromosome, while one-half of the male germ cells will have one X chromosome and the other half will lack the X chromosome. If a sperm with an X chromosome unites with a female germ cell, a female will result, while if a sperm without an X chromosome fertilizes an egg, a male will be the result. These are variations of this procedure, as when the male has two different sex Cs, an X C and a Y C. A notable case is that of the bug Protentor, where the female has fourteen smalls Cs and the male twelve small Cs and one large sex C which can be readily traced. We also have the phenomenon of sex-linkage, where the genes for certain characters are contained in the sex Cs and are consequently always found in one particular sex.

With this very brief and cursory review of the outstanding developments of heredity, we pass on to see if these facts and theories influence in any way the evolution question, leaving unmentioned many other points in modern genetics that are either less important or supported by less evidence.

In the first place, we can say that very few biologists today hold the inheritance of acquired characteristics, i.e., that somatic changes brought about by the environment can be impressed on the germ cell in such a way that they are inherited. This inheritance was assumed in all the early theories of evolution, but is not given credence today, as not a single case has been proven to the satisfaction of most biologists, and all the evidence obtained during the last 75 years is against it. Kamerer, one of the most loud-voiced of the exponents of the inheritance of acquired characters, recently died by his own hand, and it is reported that among his papers was found evidence contradictory of his own conclusions. Morgan, a leader among geneticists, and, of course, an evolutionist, rejects the inheritance of acquired characteristics, and his view may be taken as typical of most biologists today. He says in "Heredity and Sex," pp. 17-18: "It is true that the germ plasm must sometimes change, otherwise there could be no evolution. But the evidence that the germ plasm responds directly to the experiences of the body has no substantial evidence in its support. I know, of course, that the whole Lamarkian school rests its argument on the assumption that the germ plasm responds to all profound changes in the soma; but despite the very large literature that has grown up dealing with this matter, proof is still lacking. And there is abundant evidence to the contrary." If, then, the inheritance of acquired characters may be set aside as unfounded, it appears that evolution, if it has taken place, could only have taken place by direct modification of the hereditary constituents of the germ cell. What has the science of heredity to say on this subject? Can the factors or genes in the chromosomes be changed? From Mendel's simple experiments we know that when two varieties differing in a number of characters are crossed a large number of organisms differing slightly in their genetic constitution result. It has recently been found by experiment that the genes, although distinct from one another, yet frequently react physiologically on one another, and that frequently a character is due, not to a single gene, but to the interaction of several genes. This reaction and intreaction of genes again increases the number of organisms with slightly different genetic constitution that may result from the crossing of varieties. Other occurrences, even without the crossing of varieties, may happen that result in progeny of a different genetic constitution; for example, the number of chromosomes may be doubled, as in the case of one of DeVries' mutant primroses, possibly due to the failure of the reduction division to take place. Another instance, the case of non-disjunction, has been observed in which two chromosomes which should separate and one be given to each of the daughter cells fail to do so, but remain attached to one another and consequently give rise to two daughter cells, one of which has an extra chromosome, while the other lacks one that it should have. All these cases of recombination of genes, alteration in the number and position of the genes, may give us, it is true, a large number of slightly differing varieties, but we have no reason to believe that in these cases the nature of the gene is changed, and consequently these cases are of little or no use in trying to explain how evolution might have come about. They do, however, furnish us with a plausible explanation of the origin of what taxonomists call the varieties and races of a species and also in some cases of closely related species themselves. For example, Prof. Tower performed a number of breeding experiments on the potato beetle, and obtained forms that differed markedly from the original form. He also found that these new forms obtained in the laboratory existed in the wild state in nature and were regarded as separate species. Of course, this does not prove the evolution of species, since all biologists admit that the taxonomists' idea of a species is inadequate and faulty, and many of what we call varieties and species may well be members of the same species, with slightly different genetic formulae due to mendellian segregation and redistribution of genes, to the phenomenon of crossing-over, non-disjunction, duplication of chromosomes, etc.

It would seem, then, that the fiindings of heredity we have thus far briefly considered have not given us any evidence of evolution or any explanation of its possible method. It has shown us, however, in its rejection of the inheritance of acquired characters that if evolution has occurred it must have been through direct modification of the germ plasm. Modern geneticists are now seeking to solve the problem, Can the gene be modified or changed? Morgan sums up the question in these words ("Heredity and Sex," pp. 17-18): "On the other hand, there is evidence to show that the germ plasm does sometimes change or is changed. Weismann's attempt to refer all such changes to recombinations of internal factors in the germ plasm itself has not met with success. Admitting that new combinations may be brought about in this way, yet it seems unlikely that the entire process of evolution could have resulted by recombining what already existed; for it would mean, if taken at its face value, that by re-combination of the differences already present in the first living material, all of the higher plants and animals were foreordained. In some way, therefore, the germ plasm must have changed. We have, then, the alternatives. Is there some internal, initial or driving impulse that has led to the process of evolution? Or has the environment brought about changes in the germ plasm? We can only reply that the assumption of an internal force puts the problem beyond the field of scientific explanation."(?) "On the other hand, there is a small amount of evidence, very incomplete and insufficient at present, to show that changes in the environment reach through the soma and modify the germinal material."

Experiments along these lines are now being widely carried on, and the preliminary evidence seems to show that changes in the germ plasm can be brought about experimentally by such agencies as radium, X-rays, and ultra-violet light. During the last year the publication, Science, has had numerous articles describing mutations brought about by these means in many different kinds of plants and animals. Geneticists seem to hold that phenomena such as these hold the key to the explanation of evolution, hence it would be well for us to watch carefully the development of this new experimental technique and to subject its findings to critical study.

CHARLES A. BERGER, S.J.,
Loyola College, Baltimore, Md.

A LONG-LIVED DERMESTID LARVA.

(Attagenus Pellio Stephens)

On June 23, 1921, seventeen dead flies taken from a Xestocrabro sayi (Cockerell) nest were put in a glass vial for future reference. An extremely small larva of some sort had been observed when the flies were examined for the eggs of Xestocrabo, but no attention was paid to it. Inspection of this vial on Sept. 24th of the same year showed a dermestes larva feeding on the flies. From then on till the death of the larva on about April 20, 1927, the vial was inspected at regular intervals of about a month. By May 12th, 1922, the larva had molted 5 times, the smallest molt being about 1-16th inch long; by Sept. 17th, 1922, there were seven additional sloughs in the vial. By this time the larva was over a year old and it had continued feeding uninterruptedly, molting twelve times. But now its rate of molting slowed down to about three a year, in contrast to the twelve of the first year. For, by Oct. 25th, 1924, more than two years later, it had sloughed seven times. By Aug. 19th, 1926, there were seven additional sloughs. During this time the larva was decreasing in size, the smallest slough being about one-eighth inch long. The largest slough during all these years was about five-sixteenths inch long and was shed during the summer of 1924. The sloughing during these two years, therefore, was not due to an increase in size, and, it would seem, bears out the theory that molting has an excretory function.

But during the last year, from Aug. 19th, 1926, until April 10th, 1927, when it died, the larva did not slough again.

Therefore, the larva lived at least five years and six months. If the minute larva hastily noticed on June 23, 1921, was really the dermestes larva, then this larva actually lived five years and nine months. It molted 26 times.

Being only an amateur entomologist who steals odd hours from the labor of teaching zoology to fraternize with insects, I had never heard of the work of J. E. Wadsedalek until recently. Folsom reports it as follows: "Finding that larvae of the common museum beetle Trogoderma tarsale would live a long time without food, molting meanwhile, but not eating the cast skins, he tested their longevity by keeping them individually in glass vials without food. The larvae gradually decreased in size till almost their length in hatching, but were surprisingly tenacious of life. Newly hatched larvae that had never eaten lived for four months without food; quarter grown larvae, fourteen months; half grown larvae, three years; three-quarters grown larvae, four years; and full grown individuals, from four to five years, one month and twenty-nine days (one larvar). If stunted specimens were given food they began to grow again and could again be reduced in size by a second period of starvation. By alternate periods of feasting and fasting, larvae were three times brought to their maximum size and three times reduced to their minimum size."

Since in the present case the rate of molting decreased sharply around September of 1922, it might be argued that the available food supply had given out, though there remained a matted mass of wings, legs, heads, and throax covers. If such was the case, then the present larva survived starvation for about four years and seven months, a period which would conform to Wadsedalek's findings.

John A. Frisch, S.J.,
Georgetown University, Washington, D. C.

SLEUTHING A MURDERER WITH FUCHSIN

While engaged in the study of the life-history of several hunting wasps, especially Ammobia pennsylvanica and Ammobia ichneumonia, I became very much interested in their stinging habits. Like most hunting wasps, these two use insects as food for their developing larvae. But instead of killing these insects, they merely paralyze them by stinging them in the nerve centers that control voluntary movements. The egg is placed on the paralyzed victim and newly hatched larva finds for it as food a living, breathing but otherwise almost perfectly paralyzed insect which it can devour in comfort and leisure and in perfect safety. The skill and ingenuity exhibited by the wasp in thus paralyzing her victim has always intrigued observers. But what induced me most to try to unravel the wasp's technique was the size of the insects used in this case.

For these Ammobia are among our largest wasps, and hence their prey is comparatively large. Ammobia pennsylvanica uses mainly the large angular winged katydid, microcentrum rhombifolium, while Ammobia ichneumonia uses mainly the large sword-bearer grasshopper, neoconocepholus ensiger. Hence I thought it ought to be comparatively easy to determine just where and how often the wasp stings its prey to paralyze it.

It is true the capture and stinging always takes place in the field, and it would be only by a rare stroke of luck that the process could be watched in the open. Controlled captures would, therefore, have to be resorted to. Would the wasp cooperate? A trial showed that Ammobia ich. is an ideal wasp for such experimentation, bold, fearless and ready to strike her prey wherever she finds it. Thus she will attack and paralyze the grasshopper when confined with her in a bottle or even when the prey is presented to her, held in a pair of bright forceps or even when held in the bare fingers, with the experimenter's face only six inches from the scene of battle.

It was easy then to experiment and at least a dozen controlled captures were observed. From these it seemed that the wasp strikes first in the neck, presumably to paralyze the suboesophogeal ganglion and then twice in the thorax to paralyze the two thoracic ganglia. But the wasp is so quick and furious in her attack and so close to her prey that it is often difficult to be sure where her sting strikes. Also occasionally she seems to vary her method or to repeat the process, as though not satisfied with her first job. I had learned the main features of the wasp's method, but I did not know all of her tricks.

Close inspection of the victim with a magnifying glass and even with a binocular microscope failed to reveal any injury to the skin, although it may have been due only to my inaptness. Try as I would I could not make absolutely sure of where and how often the sting was used.

Then it occurred to me to try staining. The idea as it presented itself to me was to find some stain that would give a color reaction with the poison carried on the wasp's sting or with the body fluids of the insect, for I took it for granted that there would be some trace of the poison or at least some extrusion of the body fluids at the point of puncture. If now a stain for these fluids could be found it would be a simple matter to apply the stain to the neck and the thorax and note the points where the color reaction took place. These would be the points of puncture. Since the amount of poison or exudate, if any, must be small (I could not detect it with a microscope), the color reaction would be very slight and confined to a minute area. The only chance of success was in using a colorless indicator of great sensitivity. My chemical knowledge of stains is very limited and my solution of the problem I had set myself may seem crude to stain technologists. Yet my method met with quite a measure of success and I am publishing it as a preliminary contribution and in the hope of soliciting advice from those who know more about stains than I do.

The method I employed was suggested to me by Frs. Jos. Sullivan and Geo. Strohaver. I took a 5 per cent water solution of acid fuchsin and decolorized it by bubbling SO_2 through it. When fully decolorized, I applied drops of the solution to the neck and the thorax of the grasshopper. The result was that after a while very minute reddish spots appeared in the neck and on the thorax just about where I suspected the sting of entering. Immersing the whole grasshopper in the indicator resulted in a slight tinting of some other parts, but there was no mistaking the decided color at the presumed points of puncture. This may seem like complete success. But I am not quite satisfied. This indicator is not specific for the poison or body fluids; other things will restore the color, e.g., contact with the human skin. It would, therefore, be more satisfactory if an absolute indicator, a more specific dye, could be found, and it is my hope that these notes will bring some suggestion from someone more familiar with the possibilities of dyes than I am.

John A. Frisch, S.J.,
Georgetown University, Washington, D. C.

SCIENTIFIC CURIOSITY

After seeing the way students are treated in other colleges than our own, I have often asked myself the following questions: Do we not do too much of the boy's work for him? Or at any rate do we not solve more of the boy's problems than we should solve? Instead of arousing his native curiosity to the point where he will chafe inwardly until he finds a solution himself.

One example of the methods used in outside schools comes to mind. Several summers ago I was taking a course in Applied Physical Chemistry. Every night we had from five to ten problems to work out. But usually the professor would interrupt a lecture or a quizz to ask a question like the following:

1. Suppose a very sensitive thermometer hung in the open air on two successive nights, when the terrestrial temperature and other conditions were the same. On the first night there were no clouds in the sky. On the second the sky was dark with clouds. Question: Would there be any difference in the readings of the thermometer on the two nights? Give the reason for your answer.

2. Some logs are to be dried in a kiln, through which a current of warm air is passed at a known rate. Suppose the temperature of the air the same, and the rate of flow the same. Question: Would the logs dry quicker if the air were dry or if it were slightly moist? Why?

These and like questions were thrown out to the class. You were asked to make a guess, if you did not know, and of course, give a reason for your guess. Frequently the professor would leave the questions unanswered and then they were carried into the corridors and out on the campus for discussion. Next day they were brought up in class again, the various answers and arguments heard, and the correct solution advanced by the teacher.

Is it not possible for us to work up a series of problems like the above, suited to our needs in College Science—problems, which provoke thought, which stimulate interest, and arouse the curiosity of our students along scientific lines?

JOSEPH J. SULLIVAN, S.J.,
Loyola College, Baltimore, Md.

A FACT: WHAT IS THE CAUSE

In late years, one of the greatest difficulties a teacher of Physics in the college course encounters is the woeful lack of even the most elementary mathematics on the part of the student. With this in view, we determined this year to test the mathematical knowledge of the students who were about to take up Physics. Hence, in the Freshman class, at the beginning of the year, a very simple examination was given in algebra, geometry and trigonometry. This examination was simplicity itself, as can be seen from the following:

Algebra: $x\ y = m\ n$, solve for x
$x_2 - 8x + 15 = 0$, solve for x.

Geometry: Prove that the sum of the angles of any triangle is equal to two right angles.

Trigonometry: State and give the values of the different trigonometrical functions.
complete the following formulae:
$\text{Sin}\ (x+y) =$
$\sin 2x =$

The students who had not had any trigonometry were marked only on algebra and geometry. The result was certainly amazing and one would hardly believe it unless the cold results were staring him in the eyes. It must be borne in mind, too, that only those students who were among the first third in their graduating classes were admitted to the Freshman Class of Georgetown this year.

HIGH SCHOOLS

	Catholic				Non-Catholic			
Locality	No. of students	Pct. passed	Pct. cond.	Pct. failed	No. of students	Pct. passed	Pct. cond.	Pct. failed
Connecticut	0	....	....	....	3	0	33.3	66.6
District of Columbia	1	0	0	100	1	0	0	100
Kansas	2	0	0	100	0	....	....	....
Massachusetts	0	....	....	....	3	0	0	100
Michigan	3	0	0	100	0	....	....	....
New Jersey	3	33.0	0	66.6	3	66.6	0	33.3
New York	6	0	0	100	4	25	0	75
Ohio	0	....	....	....	1	0	0	100
Pennsylvania	4	0	50	50	5	0	20	80
Virginia	0	....	....	....	2	0	0	100

JOHN L. GIPPRICH, S.J.,
Georgetown University, Washington, D. C.

FATHER FRANCISCO DE PAULA SANCHEZ, S.J.
(1849-1928)

The name and achievements of Father Sanchez are well known to those readers of THE BULLETIN who were and at the present time are connected with the Philippine Mission; but for those who have never been to Manila a word of appreciation for his work and the following biographical note will be of interest:

Padre Francisco closed a long and useful life of 79 years on Saturday, July 21, 1928. Born in the village of Flix, Tarragona, Spain, on the 12th of January, 1849, he entered the Society at the age of 16. Seven years later he started his regency in Manila. Returning to the Islands after his Tertianship, he worked there practically without interruption until the week before his death. Of his 63 years in the Society, Fr. Sanchez spent more than a half century in the Philippines. For the greater part of this time he taught Natural History in the Ateneo and in San Jose. Under his direction as Curator of the Museum (Ateneo), the present extremely valuable and complete collection of shells was made. He gave his name to one of the Coleoptera and is credited with having discovered the famous Arbor Toxicaria in the mountains of Mindanao. Fr. Sanchez was a familiar figure in the halls of the Bureau of Science, and was a respected and intimate friend of the recent Director, Dr. Merrill, now in California. In recognition of his work in entymology, Fr. Sanchez was admitted to membership in the Royal Entymological Society of Spain.

Most of the prominent Filipinos of the day were taught by Fr. Sanchez. But what endeared him to all Filipinos, high and low, was the fact that he was the teacher of their national hero, Dr. Jose Rizal. This, combined with his truly valuable contributions to scientific knowledge in the Philippines, won for Fr. Sanchez "Adoption" by the City of Manila on the occasion of his sixtieth anniversary in the Society.

The whole City of Manila mourned his death, and from all sides came expressions of appreciation for his priestly and scientific labors.

F. X. REARDON, S.J.,
Woodstock College, Woodstock, Md.

NOTES

Rev. Edward C. Phillips appointed Fr. R. B. Schmitt, S.J., Director of Chemistry, at Loyola College, Baltimore, President of the American Association of Scientists (Eastern Section).

We regret to state that Fr. Brock, Professor of Physics, at Weston College, has been forced on account of illness to resign as editor of this BULLETIN. I am sure that all will join with me in extending to Fr. Brock heartfelt appreciation for his labors in editing THE BULLETIN and trust that his health may soon be sufficiently restored that he may again assume the editorship. In the meantime Rev. Fr. Provincial appointed Fr. Gipprich, Georgetown University, as editor.

Fr. Paul A. McNally was appointed Director of the Georgetown University Astronomical Observatory, with Fr. Frederick W. Sohon as assistant.

On the occasion of the Disputations held at Woodstock College last November an interesting and instructive lecture was delivered by Mr. G. A. Weigel, S.J. The lecture was entitled, "The Mountain in Its Making."

A new and enlarged Seismograph Station has recently been installed at Fordham University under the direction of John W. Tynan, S.J. Mr. Tynan has written a full account of the new station and instruments. The article is printed in the January issue of *Science and Invention.* The *Edison Monthly,* November, 1928, under the heading "Catching the Quakes," contains a detailed description of the new station.

A Meeting of the A. A. V. S. O.

Submitted by THOS. G. BARRY, S.J.

On October 20, 1928, the semi-annual meeting of the American Association of Variable Star Observers was held at Harvard College Observatory. There were about fifty people present at the meeting. At the afternoon session Messrs. John A. Blatchford and Thomas D. Barry, of Weston College, were present.

An interesting program of papers was presented. Miss Cecilia H. Payne, of Harvard, gave a paper on "Photographic

Study of Long Period Variables." D. B. Prentice and H. H. Clayton, who spent some years in Argentina and Chile in the study of solar radiation and who is now engaged in working out the possibility of long-range weather forecasting, gave a paper on "The Sun, a Variable Star." Prof. L. S. Barnes, of Lehigh University, spoke on the "Graphic Interpretation of the Occultation Reduction Formulae." Prof. E. W. Brown, of Yale, finished with a resume of the work that had been done in 1927 on the corrections to the lunar tables as a result of the occultations observed during that year. He spoke of the labor of reducing these observations, and mentioned the fact that a few observers sent in their observations already reduced, notably, Georgetown, Ohio State, and a few others. Mr. Clayton, in his talk, showed a lantern slide showing a curve, "based on observations made at the Ebro."

Last August many Jesuit scientists from various parts of the country gathered at the University of Santa Clara for the fourth meeting of the Jesuit Seismological Society. In a series of field excursions, an extensive study was made of the San Andrea rift. Among those present were: Vincent J. Herr, S.J., St. Xavier's College, Cincinnati, Ohio; Frederick L. Odenbach, S.J., John Carrol University, Cleveland, Ohio; J. S. Ricard, S.J., Santa Clara University, Calif.; Victor C. Stechschulte, S.J.; Joseph Joliat, S.J.; John S. O'Connor, S.J.; O. L. Abell, S.J., Loyola University, New Orleans, La.; George A. Brunner, S.J., Loyola University, Chicago, Ill.; James I. Shannon, S.J., St. Louis University; James B. Henry, S.J.; Albert J. Newlin, S.J.; John G. Tynan, S.J., Fordham University, New York; James B. Macelwane, S.J., President of the Association.

EXTRACTS

Recently Father Tondorf, director of the Seimological Observatory, was in receipt of a letter which incorporates a spirit of loyalty which is typical of the Alumni Association. The letter refers to a recent gift of the Rhode Island Chapter of the national alumni body, which has made possible the purchase of a new seismograph of the very latest type. This instrument is now in possession of the observatory and as the *Hoya* remarked last week, is soon to be installed in a new vault prepared for it beneath the Dahlgren Chapel.

The *Hoya* is happy to print the letter because it emphasizes two points around which a vigorous alumni spirit can be built, namely, generous and practical loyalty to the institution and personal affection for old-time professors. Dr. Michael L. Mullaney, who writes the letter, has been for years a leading force among the Georgetown men in Rhode Island. In the following letter he undoubtedly speaks in particular fashion for himself, but undoubtedly, as he remarks himself, he represents the true spirit of the Rhode Island alumni.

The *Hoya,* therefore, believes that the letter has real news value and submits it herewith:

"Dear Father Tondorf:

"Months ago when you were in Providence some of your friends pledged themselves to raise between sixteen hundred to eighteen hundred dollars to enable you to purchase a seismograph. They did this to show you that you are appreciated by the Rhode Island men of Georgetown and also as a token of their love and esteem for you.

"At this time I am enclosing you a check signed by the secretary of our organization for eighteen hundred dollars. It is our ardent wish that the little help we give you may lighten your burdens and enable you to keep Georgetown in the high place it has attained under your direction in seismology.

"With best wishes, I remain,

"Sincerely,

"Michael L. Mullaney,

"President Georgetown Club of R. I."

EDITOR'S NOTE.—All articles, notes and extracts submitted and not published in this number will appear in the next issue of THE BULLETIN.