A. M. D. G.

BULLETIN

of the

American Association of Jesuit Scientists

(Eastern Section)

For Private Circulation

LOYOLA COLLEGE
BALTIMORE, MARYLAND

VOL. VIII MARCH 1931 NO. 3

CONTENTS

BULLETIN OF AMERICAN ASSOCIATION OF JESUIT SCIENTISTS

EASTERN STATES DIVISION

VOLUME VIII | MARCH 1931. | NO. 3

EDITORIAL

The major portion of our college curriculum is devoted to the natural sciences and philosophy. By natural sciences we mean the courses in biology, chemistry, physics, astronomy, geology and mathematics; and the philosophy courses include dialectics, criteriology, metaphysics, cosmology, psychology and ethics. We, who are professors in science and philosophy spend years in preparation of our particular subject, and usually many more in teaching and lecturing. Specialization is surely commendable, but specialization and correlation far more so. Coordination in the sciences is necessary; even though the various branches are quite distinct, they intertwine and are a mutual support to one another. In the science of physics, for example, there is a correlation of several sciences: in thermodynamics there is a combination of physics and mechanics; in thermochemistry—a coalition of physics and chemistry; in optics and acoustics—a union of physiology and physics, and in medicine—a coordination of physics, chemistry and biology. Then too, we have the correlation of three major sciences in physical chemistry, biochemistry and bio-physical-chemistry. In philosophy too, correlation is fundamental and important since the principles of dialectics must be adhered to in cosmology or psychology or ethics; there is also that firm coordination of metaphysics and cosmology and of psychology and ethics.

There is a more extensive and a more important coordination, that between the natural sciences and philosophy that is highly commendable—an ideal seldom realized. A few years ago there was an international meeting of scientists and philosophers in the Eternal City to discuss this coordination. At the science convention last August an attempt was made at a committee meeting of the scientists and philosophers to ascertain what scientific facts and theories would be helpful to the study of these branches in our college courses. This subject is discussed in a letter from the Secretary of the Philosophers Association and appears in this issue.

When the requested articles appear in our pages, perhaps they will stimulate an interest among the professors of science and philosophy, and elicit constructive discussions helpful to our readers. The advantages are apparent to all since we know what conclusions are made by some reputed scientists when they philosophize about scientific theories. Recently in an article entitled: "How to Explain the Universe," we find statements such as these: "We can say only that the electron is probably in such and such a position, or that it has such and such a velocity. Hence we can never know anything about an atom and therefore about a world of atoms. PURE CHANCE REIGNS."—"No one knows why a quantum of light should fly off at one moment rather than another, or why it should effect one electron rather than another. PHYSICISTS THERE SEE CAUSE AND EFFECT DETHRONED."

Those who coordinate and correlate science and philosophy—what would they say to these startling conclusions?

Georgetown University

Washington, D. C.

To the Editor of the Science Bulletin;—

In response to the resolution passed at the committee meeting of the Scientists and Philosophers, I wish to submit the following:

Ever since Liberatore imparted new life to scholastic philosophy, a growing interest in matters scientific has been manifested by our scholastic writers. A partial or total opposition to scholastic physics on the part of such men as Tongiorgi, Secchi, Tedeschini and Palmieri has helped not a little to intensify that interest. Whether the philosopher uses the knowledge which he derives from the sciences to confirm or modify the proofs of his propositions or to designate the pernicious implications connected with certain scientific theories, there can be no doubt that the interest itself is both natural and beneficial. Since nature cannot contradict itself there should be a spirit of mutual interest and cooperation between scientists and philosophers. On the contrary however, a spirit of mutual distrust has engendered anything but harmony and cooperation.

Such an attitude among non-Catholic scientists only emphasizes the imperative need of greater cooperation between our own scientists and our philosophers. To the philospher the advantages of a closer union are inestimable. Due to lack of sufficient scientific training and a lack of time, the scholastic philosopher is not in a position to ferret out the false scientific assumptions upon which a derived philosophical system may rest. Furthermore he may find it very difficult to follow the changes which occur in the definition of scientific terms. Finally even though the philosopher may believe that he grasps the importance of a new scientific theory or the significance of some new experiment,

(*Continued on page* 15.)

REV. JEROME SIXTUS RICARD, S.J.

"Padre of the Rains"

Born: January 21, 1850, Plaisans, France.
Died: December 8, 1930, Santa Clara, California.

REV. JEROME SIXTUS RICARD, S.J.

METEOROLOGIST

..............................Omnes
Explorat ventos, atque auribus aera captat;
Sidera cuncta notat tacito labentia caelo.
Aen. III, 513.

Father Jerome Sixtus Ricard, familiarly and affectionately known throughout the United States as the "Padre of the Rains", because of his remarkable success is making long-range weather predictions, died on December 8, 1930, at the University of Santa Clara, California. He was eighty years of age, of which fifty-nine were spent in the Society of Jesus and over fifty at Santa Clara.

Father Ricard was internationally known for his development of the sunspot theory of weather forecasting. His monthly weather forecasts, based on calculation and observation of the sun, were issued regularly for a quarter of a century until he was stricken with his last illness in 1929. Although many scientists refused to accept his theories, Father Ricard defended them and his success in forecasting weather for thirty or more days was remarkable.

Father Ricard was a native of Plaisans, Drome, France, where he was born on January 21, 1850. He attended the Apostolic School at Avignon. After traveling in Africa and Italy in 1869, the young Frenchman entered the Apostolic School at Turin, Italy, and on June 1, 1871, the Jesuit Novitiate at Monaco. In 1872 he left for the California Mission and pronounced his first vows as a Jesuit on June 1, 1873. From 1874-1877, Father Ricard made his studies in Philosophy and during the three following years taught grammar and higher mathematics at Santa Clara. After three more years of teaching mathematics at St. Ignatius College in San Francisco, he commenced his four years of theological studies at Woodstock, Md. He was ordained at Woodstock in 1886 by Cardinal Gibbons. Before returning to Santa Clara again, Fatner Ricard spent the summer at Johns Hopkins University in Baltimore under Professor Craig, and at the completion of the course returned to Santa Clara as Prefect of Studies and teacher of higher mathematics. His tertianship was made at Florissant, Mo., in 1890-91. In the summer of 1890 he studied Astronomy under the celebrated Father William Rigge S.J., at Creighton University, Omaha, Neb.

From 1891-1917, a period of twenty-six years, Father Ricard was professor of ethics, mathematics, political economy and history at Santa Clara. From 1917 on, his work was mostly in the Observatory. Father Ricard was a member of astronomical societies in France, Belgium and Mexico, of the Seismological Society of America, and of the Meteorological Society of America.

Father Ricard became interested in astronomy in 1890 and devoted much time to the subject. In 1900 he took up the observation and study of sunspots, and six years of close observation and comparison with the earth's atmospheric changes, became convinced that by noting the position of sunspots, accurate weather forecasts could be made. He put his theory into practice, first with ten day forecasts, later with monthly prognostications. That there is an actual connection between the weather here on earth and sunspots has been ably demonstrated by the research work of the Smithsonian Institution in 1925 under Dr. Charles G. Abbot.

There are three principle points in long-range forecasting which Father Ricard set out to solve:—

1. The actual *date of arrival* of the storm area on the Pacific Coast. In this field of predicting Father Ricard was highly successful.
2. The actual *intensity* of these storms. Here Father Ricard's working hypothesis gave most gratifying results.
3. The actual *place* of entrance and consequent *storm track* or direction once a storm had touched land started its journey eastward. This last perplexing question was one in which Father Ricard was actively engaged in solving at the time of his death.

The success of his forecasts, his long experience and his tireless investigation in closely following the storms of earth gained for him an extraordinary confidence among all classes of people. They eagerly sought for his bulletins concerning future weather conditions and confidently relied upon them in determining their work in the fields, their daily business undertakings and even their pleasure. In recent years his forecasts were widely distributed, in California perhaps even as widely as those of the Government.

The new University Observatory was erected at Santa Clara largely through the generosity of the Knights of Columbus of California in testimony of their high esteem of Father Ricard. A great tribute was paid him by all California on the occasion of his fiftieth anniversary as a Jesuit on May 30, 1921. Over seven thousand people, old graduates, friends, civic and clerical leaders assembled at Santa Clara to honor the jubilarian.

No less a tribute to the venerable "Padre of the Rains" was manifested on the occasion of his death and burial at the old Mission of Santa Clara. From state and nation poured in thousands of messages of sorrow at the passing of the priest, the scientist and the man they had so long respected and loved.

Rev. Raymond Buckley, S.J.

A TRIBUTE

JOHN GEORGE HAGEN, S.J.

In *Astronomische Nachrichten*, 240.132 (no. 5744), is given a biography of Father Hagen, written by Father J. Stein, S.J., his successor as Director of the Vatican Observatory at Rome. A translation of the article follows:—

On September 5, 1930, Father John George Hagen, S.J., died at Rome in his twenty-fifth year as Director of the Vatican Observatory. He was born on March 6, 1847, at Bregenz am Bodensee. He lived 83 years and 6 months. His father, Martin Hagen taught school from 1815 to 1825 at the nearby town of Lochau, where his family had settled as far back as 1650. In the year 1825 he moved to Bregenz, and there also followed the teaching profession until the end of 1856, when he was pensioned. His marriage with Theresa Schick in 1841 was blessed with three sons and three daughters. The two youngest died in childhood. John, the next youngest, survived them all. After he had attended the elementary school at Bregenz from 1853 to 1858 and the technical high school for another year, he was sent to the Jesuit college at Feldkirch. The greater freedom which he enjoyed there as day scholar, he used among other things in the mountain sports, by which exercise his poor health became improved. In the year 1863, at the age of 16, he entered the Society of Jesus. After his noviceship at Gorheim (at Sigmaringen) he proceeded in 1865 to the study of the classics and of rhetoric at Friedrichsburg in Münster and in 1867 to the study of philosophy at Maria Laach. Here he became greatly interested in the study of the exact sciences, and at his own request his superiors sent him in 1870 to the Academy at Münster, where he attended the lectures in Mathematics and Astronomy of his beloved Professor Heis. The next year he studied Mathematics and Physics at the University of Bonn under Professor Lipschitz, Ketteler, Kortum, Giesen and Clausius. In 1870 he offered himself for the service of the sick in France, but after a week he himself fell sick with typhoid fever, and lost thereby another half year of his already too short academic training. In 1872 he was compelled by the May Laws to emigrate to Austria. He there taught Mathematics for three years in the four lower classes of the Gymnasium at Feldkirch. In 1875 he began his theological studies at Ditton Hall, Liverpool, and was raised to the priesthood in 1873. After finishing his theology in 1880 Father Hagen was appointed professor in the college at Prairie du Chien, Wisconsin. Here he built a small, primitive observatory, in which he began to observe variable stars.

His appointment as Director of the Georgetown College Observatory in Washington followed in 1888. Here he obtained everything he could wish for the full development of his talents: a large observatory with a 12-inch telescope and a photographic transit, a great library at the Naval Observatory, and association with specialists and scientific societies. Here also came to maturity the great plan which he had already conceived in 1883 and which was to be his greatest glory: the "Atlas Stellarum Variabilium". The observations for the first six series were begun with the 12-inch on October 1, 1893 and were completed on November 23, 1905. The first three series appeared before his departure from Georgetown, the fourth to the sixth in the years 1906-1908, the seventh, with the collaboration of Professor Graff and Dr. Esch, in Rome in 1927. In addition to the publications of the observatory, there appeared as the result of his labors at Georgetown the first three volumes of his "Synopsis der Höheren Mathematik".

In 1906, at the request of Archbishop (later Cardinal) Pietro Maffi, Director of the Specola Vaticana, Father Hagen was called to Rome by Pope Pius X. His first task was to commence the work of publication of the Astrographic Catalogue. This was carried on so successfully that the printing of the ten volumes (55° - 64°) was completed in 1928. At that time the observatory was entirely removed to the Vatican Gardens and was reorganized. In addition to the Leonine Tower, more than a thousand years old, where the Oratorian Father Lais worked with the photographic refractor for the Carte du Ciel, a similar tower was set aside for a 16-inch telescope, and the adjacent Villa of Leo XIII was rebuilt as a dwelling for the astronomers and for the library. At the same time Hagen began his historico-technical work, "The Variable Stars", in which he brought together from the original sources everything worth while which an observer might need for his own preparation and for the evaluation of his visual observations. Of his further work on star colors, on the physical explanation of variable stars, on the history and theory of the mechanical proofs of the earth's rotation, and his later experiments with Atwood's gravity machine we can here make only brief mention.

At the time of the erection of the 16-inch, Hagen had already carefully prepared a program for observation: the numerical determination of the brightness of all N. G. C. nebulae. The results of this investigation, classified according to zones, appeared in 1922, 1925, and 1927 in the three parts of the "Preparatory Catalogue for a Durchmusterung of Nebulae". The "General Catalogue" was elaborated by Dr. Frederick Baker and published in 1928.

I need not give here a detailed account of Hagen's much discussed dark cosmic clouds. It is well known how in the beginning the reality of these shapes was almost universally doubted and how Hagen always defended them with the unshakable conviction which his sharp and skilful eye had given him after decades at the telescope. The situation gradually cleared up, and the number of those who openly declared themselves in favor of their existence increased. Father Hagen in the last year of his life took great pleasure in the partial triumph of his opinion. Unfortunately he was no longer able to complete his Durchmusterung of the dark clouds, on which he had worked for ten years.

In the beginning of March Father Hagen caught a cold, resulting in catarrh and fever. With all his will power he strove to fight off the bodily inertia which was coming on, because he wished, at any price, to begin, on March 19 (after the full moon), to fill out the gaps in his Durchmusterung. But on March 18, the fever ran so high that he had to be brought to the German College for treatment. Thence he was brought at his own request, on June 12, to the Novitiate of Galloro (Ariccia), and there, in the pure, fresh mountain air, he began to feel better. Meanwhile his active spirit could not rest; he corrected the proofs of the fourth part of his "Synopsis", and the manuscripts of the "Miscellanea" of the Observatory, and even composed for "Naturwissenschaften" an article on the investigations of the Foucault pendulum (which appeared Sept. 19). This bears witness to his surprising freshness of spirit. With his never failing optimism he hoped to be back at the Observatory again by the end of August. But in the beginning of August his condition became much worse, and on August 19 he had to be taken to the Sanatorium Quisisana because of nephritis. Soon all hope dwindled, and on September 5 he passed away quietly and holily, as he had lived, at peace with God and men. This kindly and friendly priest had no enemies, but countless friends and admirers. How highly he was esteemed not only as a teacher but also as a noble and beloved man was shown by the heartfelt congratulations that poured in upon him from all parts of the world on his eightieth birthday.

Father Hagen was a born observer and organizer and was gifted with an astonishing capacity for work. Whatever he undertook, he carried to a successful conclusion. With his clear methodical genius he always knew how to arrange his program of work even to details in such wise that it could be completed in the natural space of a man's life, and suited it to the means and strength at his disposal. And then he brought it directly to its completion with an iron will and an unshakable power of endurance. To follow his program through perseveringly never to be led astray, requires self-control and strength of will. It is characteristic of the man, that Hagen in his astronomical career of nearly fifty years never made any sensational discovery, never once found a new variable star, although hardly anyone has worked in the field of variable stars as much as he. So much the more lasting is the nature of his life's work; his name shall be mentioned to his imperishable glory among the great astronomers of his time.

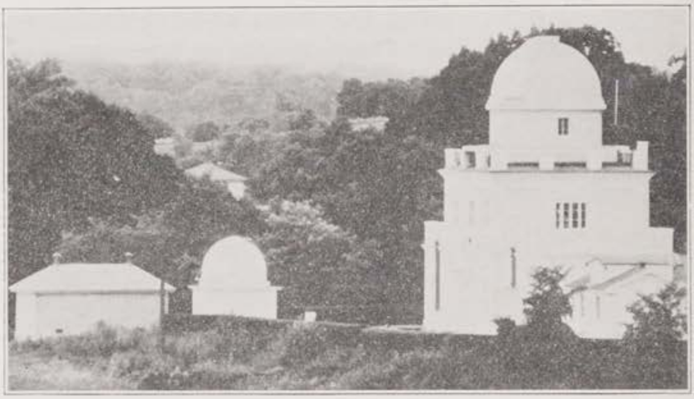
Communicated by
T. D. Barry, S.J.
Weston College.

ASTRONOMY

THE APPROACH OF EROS.

REV. P. A. McNALLY, S.J.

About the end of January we will pass very close to the asteroid Eros, which is our nearest known permanent neighbor in the solar system, aside from the Moon. As the Earth and Eros revolve around the Sun, the Earth passes Eros every two and a third years, on the average, but on account of the eccentricity of Eros' orbit the distance between them at such times varies greatly. The coming approach will be the nearest since Eros was discovered by Witt of Berlin in 1898.



Georgetown Observatory

The close approach of Eros will furnish more accurate determinations of the distance of the Sun and the weight of the Earth-Moon system. Hence, many observatories are now giving special attention to the observation of this tiny visitor.

Measuring the distance to the Sun has been one of the most important and difficult astronomical tasks. From the observed positions and motions of planets and comets, their orbits can be computed and diagrams can be drawn without knowing the actual distances in miles. Relative distances, in stellar as well as in planetary space, can be determined by various methods; but until some distance is determined in known units, such as the mile, the actual dimensions of planetary or stellar space are unknown. If, however, any one distance can be determined in miles, the scale of the whole planetary and stellar system is known. The simplest method of measuring one of these distances is by triangulation, just as distances to inaccessible points on the Earth can be determined by angular measures from a base-line used in surveying the solar system may be any known distance on the Earth, such as that between two observatories or the distance that an observatory moves in a certain time due to the diurnal rotation of the Earth. The longest base-line possible is so short that the angle (parallax) to be measured is small, and it must be determined with great precision if accurate distances are to be obtained. It is obviously impossible to make accurate direct measures on the Sun itself. Even a planet like Mars is so large and so bright that accurate measures of its position are extremely difficult.

The asteroids are small, and accurate measures can be made on their star-like images; but until Eros was discovered the known asteroids were too far away to be of much help in this problem. As soon as the orbit of Eros was calculated, it became evident that it would sometimes be much closer to the Earth than any other planet and that measures of its parallax would give a very accurate determination of the distance to the Sun.

Eros was the 433d asteroid to be discovered in the 98 years that had elapsed since the discovery of the first of this numerous family, and although nearly a thousand more have been added since, none has been found which comes closer to the Sun. Its mean distance from the Sun is 1.761 astronomical units, a little greater than that of Mars, which is 1.524; but the eccentricity of the ellipse in which it travels is so great, 0.223, that at perihelion it comes in much closer to the Sun than Mars. The least possible distance between the Earth and Eros is 13,840,000 miles. This distance is reached when Eros is in opposition exactly at perihelion. Eros will be in perihelion January 17, 1931, but the Earth will not yet have overtaken it and their nearest approach does not occur until 13 days later when the two planets will be 16,200,000 miles apart. At the close approach in December, 1900, Eros was nearly twice that far from the Earth, 30,000,000 miles. Even that was much nearer than Venus and Mars ever are; and the measures of Eros made at that time gave one of the best determinations of the distance to the Sun.

The mass of the Earth and the Moon can be determined by their attraction on Eros. The perturbations of the Earth and Moon on Eros will be large, and the difference between the observed and computed positions of Eros will give corrections to the mass of the Earth-Moon system. Since the effect of the Moon will vary with the relative positions of the Earth, Moon, and Eros, the mass of the Moon alone may also be obtained; and it is very probable that the value thus found will be more accurate than any now available.

In addition to these things which Eros can tell us, it is of interest in itself. Each asteroid whose orbit is determined adds to the statistical data of the family history, and the one which marks the extreme boundary of the asteriod region, as Eros does, is of exceptional importance. The asteroids are individual planets possessing physical characteristics just as the Earth and Moon, but they are so small that no direct observations can be made of their surfaces. The largest asteroid is Ceres, 480 miles in diameter. Only four are large enough to have had their diameters measured directly, and most of them are too faint to be measured with the interferometer. If the reflecting power of the surface, the albedo, is assumed, the diameter of an asteroid may be estimated from its apparent brightness. Several of the very faint ones cannot be much over a mile in diameter, unless their albedoes are very low. The diameter of Eros thus estimated is about 15 miles.

Several of the asteroids vary in brightness, and Eros is among them. Its total variation is sometimes more than a magnitude but at other times it shows no variation at all. The obvious explanation is that such asteroids are not spherical or that the reflecting power of their surfaces is not uniform, and that they have an axial rotation. The rotation period of Eros is 5 hours and 16 minutes, and during this interval its brightness passes through two unequal maxima and minima. The lack of variability at certain times may be due to a very high inclination of the equator of Eros to the ecliptic. Many details are still to be worked out before the explanation of the peculiar variability of Eros is complete, and it is very likely that observations made at the coming opposition will contribute materially to the solution of this problem.

When brightest, the magnitude of Eros will be 7.1, not quite visible to the naked eye but easily seen in a small telescope. Its rapid motion will make it easy to identify.

NOTES ON OCCULTATIONS.

THOMAS D. BARRY, S.J.

In "The Astronomical Journal" for November 5, 1930, there is an article entitled "Compilation and Discussion of 746 Occultations Observed in 1928," by Ernest W. Brown and Dirk Brouwer, of the Yale University Observatory. Of the total number of occultations utilized in the discussion, 36 were observed and reduced at Georgetown College Observatory, and 1 at Weston. In addition to these, 14 unreduced observations from Zi-Ka-Wei and 8 unreduced observations from Creighton University Observatory were used. Thus nearly 8 percent, of the total material was observed at Jesuit stations. The results of all the observations were combined in least squares solutions according to lunations, bright limb observations and those giving large values of $\sigma' - \sigma$ (see the BULLETIN for March, 1929) being given half weight. For the year, the mean error in the longitude of the moon is $+ 6.''32$, as compared with an error of $+ 6.''92$ for the preceding year. This shows that the moon is approaching its predicted orbit.

Father Frederick W. Sohon, S.J., of Georgetown University, discovered a short cut for obtaining step 43 in the reduction of an occultation (see the above-cited number of the BULLETIN). On the D scale of a slide rule set the value of $(a' - a)^s$ taken from step 23. Opposite this set the T scale at 10° 50′. Opposite 2 δ' on the S scale (the value of δ' is taken from step 17), the value of step 43 is read from scale A. For the placing of the decimal point, the following rule will serve:

To $(a' - a)^s = 6^s.1$ corresponds .01 for step 43,

19.1	.1
60.6	1.0
191	10.0

For the corrections to the right ascension and declination (steps 22 and 25), critical tables may be constructed giving the values for $\Delta\,\alpha$ and $\Delta\,\delta$ for which successive values of their product by .182 may be found.

Letter from Philosophers Association.

(*Continued from page 5.*)

he feels reluctant to express his approval or disapproval for fear that his interpretation may be incorrect. The uncertainty diminishes his effectiveness.

Our scientists are in a position to clarify much that is obscure to the philosopher. Moreover they can suggest what value is to be attached to theories and the experiments upon which they are based. For instance, we are told that the law of the conservation of matter has been disproved, that loss of energy means loss of mass, that loss of mass is loss of matter, that energy, mass and matter are convertible terms, that energy is radiated and that the invisible radiations of the universe tend toward annihilation, that all radiations, heat, X ray, cosmic, etc., though differing by wave length have essentially the same nature as light, that the wave theory of Huyghes and Fresnel have been discarded and a partial return to the Newtonian corpuscle is in order, that the light wave is a combination of corpuscles and wave front, that all matter can be reduced to protons, electrons and photons, that G. P. Thomson's experiment has shown that protons and electrons are nothing but bundles of energy, that the photon which we might mistake for a quantity of matter is nothing but a bundle of energy having extension without matter. Everything is thus reduced to energy. These theories have a bearing on our concepts of substance, laws, change, time, space, "actio in distans," "continuum" and practically all our metaphysical principles. Their proper evaluation therefore means much to the philosopher.

In view of the mutual advantage which could be derived from an interchange of ideas, the joint committee of Jesuit scientists and philosophers which met at Holy Cross College last August, proposed the following subjects for consideration and discussion:

Relativity and the Time-Space concept.

The latest scientific data pertinent to the question of a "Continuum."

The nature of mass, matter and energy according to the most recent theory.

The existence of ether.

The precise difference between physical and chemical changes.

The nature of the electron, proton and photon.

Means of measuring geological periods.

Inherited qualities.

The relation of organic conditions to thought, emotion and will.

The precise part played by physical and chemical activities antecedent to or concomitant with sensation.

A syllabus of what is merely probable and what is certain in biology.

It was decided at that meeting that a series of papers should be written on these subjects by members of the science body, and that these articles should be discussed by the philosophers. By means of such articles the philosophers would be kept in touch with the latest discoveries and theories of science. The replies of the philosophers would indicate to the scientists the philosophical principles which were corroborated or endangered if not contradicted by the theories, and thus provide them with a negative norm.

The modern non-Catholic antagonism between science and philosophy is unnatural and frustrates more rapid advance in both fields of knowledge. The measures taken by the joint committee of Jesuit scientists and philosophers for a mutual discussion of subjects common to both cannot help but stimulate interest, arouse deeper and more exact investigation and clarify much that is obscure.

Signed: Rev. Francis E. Lucey, S.J.,
Secretary of Philosophers Association.

BIOLOGY

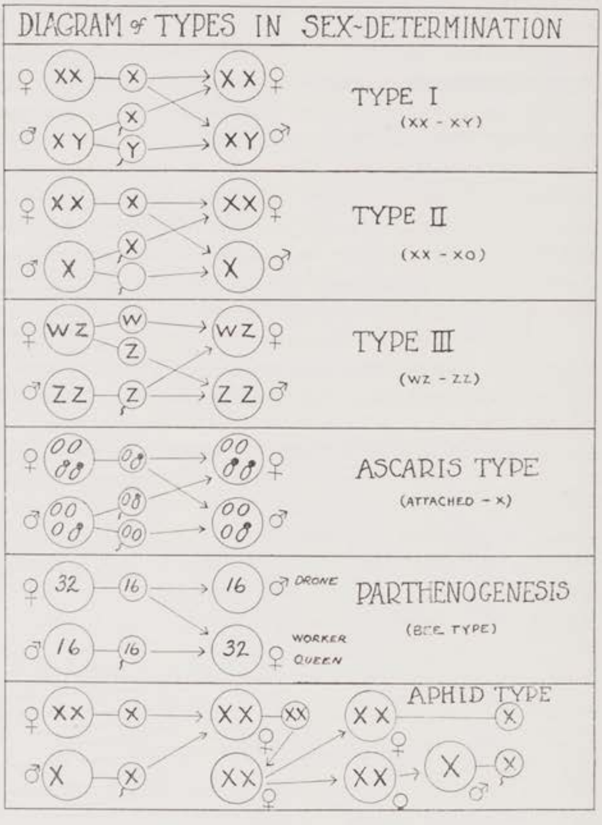
Sex-determination and Sex-chromosomes.

Charles A. Berger, S.J.

The nature, determination and inheritance of sex is one of the fundamental problems of biology. The earliest scientific attempts to remove this problem from the realm of mystery were made towards the close of the nineteenth century. These early researches were carried out in the hope of identifying the sex-determining agencies with environmental factors, they were inconclusive however and much contrary evidence has more recently been gathered in cases where changes of environment failed to influence the determination of sex. The most fruitful idea emerging from this early period of research was the conclusion of Geddes and Thomson (1889) that the sexes differed in their metabolism. This idea has more important bearing on the question of the nature of sex than on the question of sex determination.

Following this first period of sex investigation came a second in which sex began to be regarded as being determined by an internal cell mechanism or condition, in such a way that once determined the sex could not be changed by environmental agencies. Much experimental evidence for this view was uncovered at the beginning of the twentieth century such as the plus and minus strains of certain molds, the alternation of generations in bryophytes with its bisexual sporophyte and its unisexual gametohytes etc. The discovery of the difference in the chromosome constitution of the sexes in certain species was seized upon by McClung as supplying the necessary cell mechanism for the internal determination of sex. Since the introduction of this idea sex-chromosomes have been found in a large and ever increasing number of animal species and in some plants. Morgan and his associates have greatly strengthened the theory by their extended researches on the inheritance of sex-linked characters, i. e. characters that accompany sex and whose genes are in the sex-chromosomes. According to Morgan the evidence at present seems to show that sex is determined either by a balance between all the chromosomes (and consequently between all the genes) or by certain definite sex-determining genes. Morgan himself inclined toward the latter view. At present it seems very probable that the three theories of environmental agency theory are in no way contradictory to the internal mechanism reconciled and combined to give us something very near the truth.

Here again Morgan has done great work by his masterly analysis of the situation and by showing that many points in the environmental agency theory are in no way centradictory to the internal mechanism theory when the latter is properly understood. For this proper understanding we must remember that when chromosomes or genes are spoken of as 'determiners' what is meant is that they are differential modifiers in the complex reaction systems of development and that



their determining effect on the end result comes only after a prolonged series of reactions and is dependent on the environment in which the development takes place.

The statement that the number of chromosomes is constant for any given species is one of the great generalizations of modern biology commonly spoken of as a 'law' and rightly so if we add the necessary modifications required to take care of exceptions. Many cases have been found where one sex of a certain species differs from the other by having one more chromosome or one less. Many other cases are known in which while the number is the same in both sexes, one sex has two chromosomes that differ in size and shape and do not constitute a pair as is the general rule for all other chromosomes. Since these differences in any species are constant and constantly associated with a certain sex, one pair (complete or incomplete) of chromosomes in any species have come to be regarded as the sex-chromosomes and the remaining pairs are termed autosomes. In many cases sex-chromosomes can be distinguished from autosomes by striking differences in size and shape.

Three types of sex-determining chromosomes mechanisms have been worked out. In the first, called the XX - XY type (described by Stevens the female has a pair of similar sex chromosomes called X X and the male has a pair of unlike sex-chromosomes, one an X chromosome like those of the female, the other of different size and shape called the Y chromosome. At the maturation or germ cells the female forms eggs each containing one member of each pair of autosomes plus one X chromosome; in the male two kinds of sperm are formed in equal numbers, one kind having one member of each pair of autosomes plus an X chromosome the other kind having one member of each pair of autosomes plus a Y chromosome. If an egg is fertilized by a sperm having the X chromosome the resulting individual has two X chromosomes and is a female; if an egg meets a sperm carrying a Y chromosome the new individual has an X and a Y chromosome and is a male.

In the second type (described by Wilson) called the XX - XO type the female again has a pair of like sex-chromosomes called X X while the male has only one unpaired sex-chromosome, an X like those of the female. There is no Y chromosome in males of this type, its absence is designated by O in the type symbol X O. Hence in species of this type the species number of chromosomes is one less for the male than for the female. At maturation all the eggs come to contain one X chromosome while half of the sperm have X and half are without the X. At fertilization the union of an X sperm with an egg gives a female while the union of an O sperm with an egg gives a male.

In both the first type (XX - XY) and the second (XX - XO) the female is determined by the presence of two like elements X X. The third type, called WX - ZZ, is similar to the first in that the chromosome number is the same in male and female but differs from both first and second types in that the male is determined by the presence of two like elements Z Z while the unlike pair of sex-chromosomes W Z determines the female. In this type the male produces only one kind of sperm, Z, while the female matures two kinds of eggs one carrying W the other Z. Hence in type I and II the sperm may be said to determine the sex of the offspring while in type III the egg does the determining.

In a few cases sex-chromosomes are known to be attached to autosomes, they have been detected by their occasional seperation as in Ascaris of the XX - XO type.

Sex-determination in parthenogenesis also bears out the modern internal mechanism theory. In Aphids and Phylloxerans of the XX - XO type the male should produce two kinds of sperm, one with X the other without. The half of the sperm without X degenerate so that all functional sperm have an X and when they fertilize eggs produce all females called stem-mothers which give rise to a succession of parthenogenetic females. After a time some of these females produce sexual females whose eggs undergo maturation and become normal haploid eggs; other females towards the end of the parthenogenetic cycle produce smaller eggs which mature, reducing to the haploid number, and develop parthenogenetically into males.

In the case of phylloxerans, aphids, daphnians, rotifers and bees all fertilized eggs give females and in all these cases maleness accompanies the haploid, femaleness the diploid condition.

In hermaphrodites containing both ovary and testis no sex-determining mechanism has been found and none is expected as all the individuals are the same.

The Metabolic Theory of Sex. (Goldschmidt and Riddle)

In this theory sex is determined by the *rate of metabolism* in the embryo. The investigations of Riddle, Whitney, R. Hertwig and others seem to show that maleness is connected with certain conditions of the egg such as the presence of large amounts of water and higher oxydising capacity, whereas eggs with smaller amounts of water and lower metabolic rates are associated with femaleness. Goldschmidt holds that there are certain substances in the egg which determine the rate of metabolism and the sex. It seems quite probable that the chromosome theory of sex determination and the metabolic theory of sex will be reconciled and found to be supplementary to each other since Goldschmidt treats genes as enzymes or substances which produce enzymes and Morgan insists that genes are related to the end result or adult character only by a long intermediate series of chemical reactions and physiological processes.

Objective Methods of Teaching High School Biology.

AUSTIN V. DOWD, S.J.

In Vol. VII, No. 4 of the "Bulletin" several objective methods of teaching high school Biology were given; chiefly in regard to examinations and laboratory tests. In this number the Biology Home Theme will be discussed along the same objective lines as laid down in the preceeding number.

In teaching Latin, Greek, and English, we find it necessary to give as assignments, themes to be done at home. This is important also in Biology, but the form of course will be quite different.

In the study of Botany many practical themes will be suggested. First of all we have the study of cell division. Most high school students will not have the chance to witness this under a microscope. But nearly all text books have excellent pictures based on microscopic photographs. The theme will then consist in drawing, i. e. reproducing these drawings or pictures, and explaining the different steps of cell division. This will not take very long, and it will help to impress on the young student what is meant by cell division. If this theme is assigned before cell division is explained in class, it has the value of a prelection, and the class explanation will mean something to the student, and not be a maze of mysterious nomenclature, signs and figures.

When the flower is to be studied, the theme work will consist in bringing one or more flowers, pinned or pasted on a sheet of paper (typewriter size). The different organs of the flower should be pointed out, and their functions explained. The best way is to have arrows or other indicating signs point out the organs, and on another paper the functions of these organs can be explained. This was tried at the Ateneo, and the result was a better understanding of the flower, and a corresponding increase of interest in the subject. In the United States this work might involve some difficulty, as the season of flowers is in April and May, when the flower already has been studied, and when repetitions are coming on. Still some of this work could be done as a review, or at least, it could be accomplished in a field trip.

In the study of the seed several practical experiments can be done for homework. These given here are all taken from laboratory manuals, and no doubt most of them will be done anyhow in the laboratory. However there is a distinct advantage of having the student perform these experiments in private, for then a personal interest is aroused, and working "on his own" the student will derive more benefit, than from the same experiment done in the laboratory.

No trouble will be had in obtaining a cigar box which will be the garden for the private experiments; saw dust will be also easy to obtain, in which to plant the seedlings with which the student is to make his experiments. The first experiment to be performed is one to show the value of the cotyledon to the growing plant. Six seedlings should be planted; when the cotyledons appear, break both off two of the plants, one off two others, but they should be allowed to remain on the remaining two plants. At the end of a week the six specimens can be pinned or pasted on a sheet of paper, and on another paper the student can make his observations and conclusions. Another old but useful experiment can be tried with bean seedlings. The student is given seven seedlings. These are planted in his garden at home. After each day, one seedling is removed and drawn as it appears. After six days the student will have the six stages of growth of a seedling for six days. On the seventh day the seedling is removed, and pasted on the paper in its proper place in the series. On another paper he will write his observations. The boys at the Ateneo performed this experiment at home, and it was surprising how much interest was aroused. A special place in the laboratory was provided for the gardenettes of the Boarders..

There is a good experiment to show the value of the endosperm of the corn grain, six grains are used; the endosperm is removed from two of these, when they are planted; in the second two grains the endosperm is removed and starch paste is substitued but the last two are not changed in any way. After a week the six seedlings are removed from their garden and pasted on a sheet of paper, and on another paper the student writes his observations and conclusions. By the time this experiment is to be performed the student will have learned that the endosperm contains starch, and this experiment is to show the value of this starch in the growing seedling.

These and similiar experiments can be found in the Laboratory Manuals or some of the text books. When we enter into the field of zoology it is not so easy to find experiments that can be done at home. However certain projects can be suggested that can be done at home, and these will stimulate interest, and help the student to pass his free time profitably. The Hunting Wasp can be described, and also his habitation, and the students can try to find these, make observations upon its habits, and prepare a report for class. When it is time for mosquitoes to lay their eggs, the Professor can suggest places where they can be found, or suggest to the students that they prepare receptacles for them. These then can be gathered and placed in small jars and covered with netting, so that their development into the larvae, up to maturity can be studied. The student can then make a report on his observations. The same plan can also be followed in regard to frogs.

At the Ateneo the High School students for two years were obliged to make a collection of insects, while pursuing the course of High School Biology. In the public high schools in the Philippines, the students must make a collection of fifty different species of insects. This would be impossible at the Ateneo as the course of studies is a combined classical and scientific course, and the student must take at least three more courses per year at the Ateneo than in the public high schools. However the first time this was tried, it was decided that the Students could bring in ten different species. The next year this was doubted. The insects had to be mounted on board or cardboard, and catalogued down to the Order in which they belonged; spiders, scorpions and millipedes and centipedes could be substituted for insects. Four months was the alloted time to make the collections, and failure to do so, was penalized by a heavy loss of marks. Some very good collections were made, one boy being interested enough to gather about 50 insects besides several fine species of lizards, snakes, and he added to this about six or seven frogs. Several species were added to the Insect Collection of the Ateneo Museum, and the rest were put aside for laboratory work for the next year. We always urged the students to keep their collections after they had been submitted and marked, but none of them did so, which was really what we wanted.

With the larger animals, it may be impossible to do anything in the way of practical homework. Some time however a short descriptive essay of the organs and functions of the animal will do very well. This is a good test of what a boy really knows if he can express his knowledge of a subject in a short concise essay, in which brevity will not do violence to charity and accuracy. Many boys do very well in the question and answer method, but miserably when they are forced to write an essay on the same topic.

As in Botany short five minute laboratory tests can be given in zoology. With the fish, frog, bird, reptiles and mammals drawings were made in which the organs were erroneously juxtaposed, in such a way that only the most observant could detect the mistake. This was done of course after the animal in question had been studied in the laboratory. This method of quick laboratory tests was also tried on the Freshman Pre-Med students who were studying comparative anatomy, and it was surprising how few good marks were made. Yet many who did not do well could indentify all the organs of the animal when actually at work in the laboratory. But when a drawing was submitted to them in which the wrong names had been given to certain nerves or muscles, or these were placed in the drawing where they did not belong in the true animal, they were a bit at loss to account for these mistakes.

When the subject of human anatomy and physiology has been reached a few practical lectures on first aid to the injured and drowning can be given. These will make the subject not only interesting but useful. Most high school students, unless they take courses of Biology in College, soon forget what they have learned in high school. It is necessary therefore to impress certain things very definitely on the high school students' minds that will remain there when the main mass of biological facts have disappeared. These are a clear cut definition of Biology; what is it that places matter in the living state, and distinguishes it from non-living matter. A clear cut knowledge of the living functions must also be known and understood both in the plant and animal kingdoms, and how they are performed in the various species of both, so that the student can have a picture of the whole field of Biology as the science of living things, or of matter in the living state, and not divide and subdivide the science in his own mind so that the different parts or subjects remain divided and are not linked up as harmonious parts of an integral and homogeneous whole. Certain phases of the study give the student useful information, viz: the study of saphrophytes their economic importance, the study of plant life and its environment, bacteria their usefulness and harmfulness, and anything else that gives to the student facts of economic importance, such as the study of insects. Added to this a useful knowledge of First Aid is also benefical. The Teacher interested in this can find ample material in the Boy Scout Handbook, or the little handbook of First Aid that is published by the Bauer and Black Company of Chicago. These lessons could be given in a few class lectures and should add to the student's stock of knowledge of the human body.

These few ideas on objective methods of teaching high school biology, we hope will be of some aid to Ours now engaged in teaching the same subject. The Author has found them very helpful, and hopes they will be of use to others.

THE POSSIBILITIES OF RESEARCH IN A HIGH SCHOOL.

To many students of high school age, the word research is very intriguing. They even prescind from attempting to diagnose it. In their minds it requires too great a knowledge of science and its puzzling problems. There seems to be no way of attacking it with the seemingly scant knowledge of science which they have acquired in their own lecture halls and laboratories.

Yet there is a way to bring about a lust for this research, which is capable of so fascinating an eager student, that he wants to be delving into details, which at one time seemed impracticable to him.

There is always the greatest satisfaction derived from performing an experiment that requires precision and care. This type of work not only teaches boys to be exact in their actions and deductions but it may also bring out a hidden love for scientific research.

Many of these students who are interested in solving scientific problems or even testing the authenticity of its theory, may develop very quickly once they have begun their studies in medicine.

The newspapers, at one time, were devoting much space to cancer theories. New serum discoveries were brought before the attention of the medical society together with data showing their results. There seemed, however, to be so many conflicting theories as to the source, treatment and cure, for cancer, that it was necessary to closely follow developments before choosing any one theory and calling it a fact. These conditions led to almost daily class discussions and a boy would argue, using as his weapon of defense some article or report which he had clipped from a newspaper or magazine. Many of these boys noted the value of white rats in the many experiments performed. It was also noted that these animals might be used in other ways. They became inquisitive and finally sought out some experiment whereby they too, might test the value of white rats in Research.

The experiment they decided upon is one which the facilities of their laboratory will accommodate and one which may be performed with the satisfaction of privacy. The subject of their experiments is Vitamines. Lists of foodstuffs are now being carefully prepared. Three rats will be used, each one eating a diet selected for him. The abnormal, normal and subnormal developments in growth will be recorded together with and sudden change in the animals' actions. The necessity for careful preparation has been stressed and at present the work is going on with the skeleton of the experiment almost complete. Work will begin with the new term and perhaps in a later issue we might be able to better describe our results. An experiment of this type should not only create interest but should be very fascinating to the boys who are actually handling every detail.

This experiment, although it may not be thoroughly successful in our first attempt, will certainly develop the technique of the students and show them the value of precision in work of this type.

Weekly reports will be read to members of the Research Club and the developments which are noted on the observation charts will be studied.

A PRACTICAL EXPERIMENT IN BACTERIOLOGY.

As one of our experiments performed before the Research Club, we prepared three cultures of bacteria taken from the hands and mouth. The agar agar was prepared and placed in three petri dishes which had been thoroughly cleaned and dried with ether. Two boys were asked to wash and scrub their hands with liquid green soap. This process lasted for about five minutes. A sterilized probe was used for scraping the skin between the fingers and under the nails. Two cultures were injected with these and a third was made up of saliva from the mouth. The petri dishes were then placed in a warm spot in the laboratory. Development was very rapid. The results were discussed at a meeting of the Research Club one week from that date. This experiment was well received as we had previously been discussing the preparations preceding an operation. This fitted in well with our lectures on Surgery.

Human specimens in a laboratory are the cause of much discussion and afford good material for lectures. We thus undertook to try a discussion on the Human Nervous system, using a brain as a specimen and pointing out the various parts as they were mentioned. The tissue of the brain was opened so that the white and gray matter might be contrasted. The subject was a difficult one but was treated very cleverly by the lecturer. A boy compiled all the notes and made the identifications on the specimens. This interested his audience because many of them were students who never studied science. The effect of poisons and narcotics on the nervous system was shown. Several type drugs were discussed and their various results pointed out. This lecture was perhaps one of the best ever delivered by a student before the Club. We now have preserved organs of a cat which were removed during the holidays. These will be used in technical work. We will then be able to have a special series of slides which can be used for outside study.

These articles are prepared and submitted by the Research Club of Brooklyn Preparatory School., Brooklyn, N. Y.

CHEMISTRY

MICRO—METHOXYL DETERMINATION.

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

The microanalytical determination of organic radicals is important in establishing the formulae of the many organic compounds which have this active group. Reliable micro methods are now available, gravimetric and volumetric, for the determination of the methoxyl and ethoxyl groups. The pioneers in the microanalytical methods of these radicals are Prof. Zeisel, A. Friedrich, J. Herzig, J. Meyer, all of Vienna; also M. Ripper, F. Wohack and A. Klemenc.

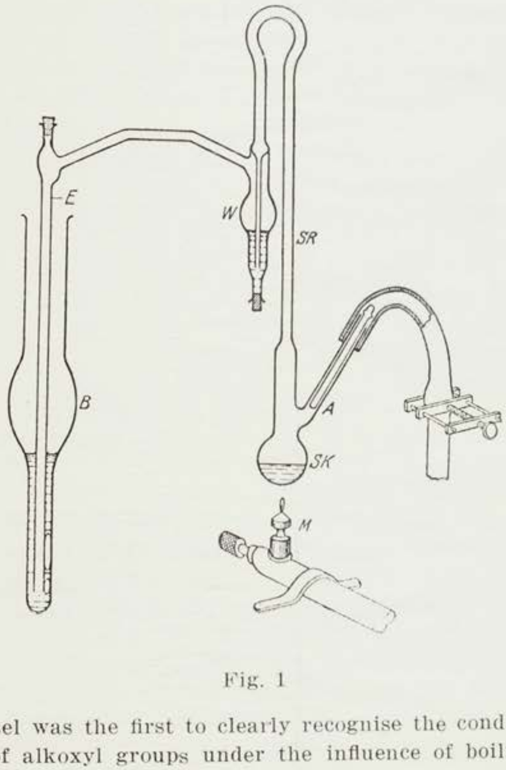


Fig. 1

Prof. Zeisel was the first to clearly recognise the conditions for the liberation of alkoxyl groups under the influence of boiling hydriodic acid in the form of alkyl iodide, and its application to the micro determination of the methoxyl radical. Ripper, Wohack and Klemenc have perfected a volumetric microanalytical method of determining methoxyl in glycerine and alcohol. (Zeitschr. f. d. landwirtschaftliche Versuchswesen in Österreich, 19, 372; 20, 102; Monatschefte f. Chemie, 34, 6.)

We will give here merely an outline of the micro-Zeisel determination of the methoxyl group. The principle reaction involved in this method is the formation of methyl iodide from the reaction of methoxy compounds with hydriodic acid in an alcoholic silver nitrate solution the silver iodide is weighed and the methoxyl group is calculated.

Reaction

$$ROMe + HI = R.OH + MeI$$
$$MeI + AgNO_3 = AgI + MeNO_3$$

Calculation

$$\log(\text{wt. of AgI}) + \log(\text{factor}) + 2 - \log(\text{wt. subt.}) = \log(\%\ OCH_3)$$

The apparatus used (Fig. 1) consists of a boiling flask SK, with a capacity of 3 or 4 cc. with an ascending tube SR, and a side tube A for the introduction of the material and of carbon dioxide. W is the washing tube; E a delivery tube; B the receiver and M the micro burner. The ascension tube SR of the boiling flask is bent over at the top and is sealed to the washer W, which holds an aqueous suspension of washed red phosphorous; it is filled from below before each determination by means of a narrow glass tube, while the apparatus is held in an inclined position. A mixture of equal volumes of 5 percent sodium thiosulphate solution and 5 percent cadmium sulphate solution (propoesd by Friedrich) has been found to give better results than the red phosphorous. The long straight portion of E is open at both ends; the upper portion of which has a slight constriction for holding a drop of water to make a seal, so as not to be effected by the vapours of methyl iodide. The receiver B is made from a test tube. This is charged with an alcoholic solution of silver nitrate. It has been found that methyl iodide is quantitatively absorbed in the narrow lower portion of the test tube, if this latter has a diameter of 7 or 8 mm., and a length of 50 mm.

Prof. A. Friedrich suggests another improvement in the Zeisel method; namely, that the interaction of the alkyl iodide with the alcholic silver nitrate solution is the less complete the more alcoholic silver nitrate is used. The error so caused amounts to .06 to .07 mgm. AgI per cc. of alcoholic solution. He therefore suggests that the receiver should be charged with exactly 2 cc. of that solution and that .12 mgm. of AgI should be added as a correction to the amount actually found.

It is essential for the complete liberation of the methoxyl groups that the substance should be completely in solution. So Friedrich converts the substance into tablets which are first dissolved in the boiling flask in either phenol or acetic anhydride, according to their solubility, before the hydriodic acid is added. He adds a small piece of tin-foil weighing about 20 mgm. rolled into a small ball, in order to prevent bumping.

It has been found absolutely necessary to dry the boiling flash before each determination. This is best done by attaching the connection from the pump to the side tube, and aspirating a rapid air current with gentle warming. In order that the precipitate may be removed quantitatively it is necessary that all glass surfaces which come into contact with this precipitate should be perfectly clean. For this purpose, the washed widened test tube is filled with sulphuric-chromic acid mixture, into which the delivery tube of the apparatus is placed. After a few minutes the delivery tube is rinsed within and without with distilled water. The washer is filled with 3 or 4 drops of the sodium thiosulphate solution and an equal quantity of cadmium sulphate. The outside of the gas delivery tube, after being rinsed with water, is finally washed with alcohol, a precaution which has been found to be very advantageous. A drop of distilled water is then introduced into the upper opening with a glass rod and the cork stopper inserted. The ascending bubbles in the receiving tube are flattened on account of the narrowness of the passage, and an ample surface contact between them and the alcoholic silver solution is thus produced, which ensures the completeness of the absorption.

The apparatus is now charged through the side tube with 1.5 cc. of pure hydriodic acid, sp. gr. 1.70, and then with two drops of acetic anhydride or a few crystals of phenol, or sometimes with both; the mixture has proved very satisfactory. Finally the weighed material is added. The side tube is closed by inserting a glass stopper, and this is then connected with a Kipp carbon dioxide generator by rubber tubing which passes over the protruding end of the stopper and over the side tube. By putting a few pieces of cotton wool in the other end of the rubber tube the gas current is easily reduced to such a point that there are never more than two bubbles passing through the silver nitrate solution at any one time.

A very small non-luminous flame from the the micro-burner is now placed at a distance of about 15 mm. below the boiling flask. The consequent warming produces an acceleration of the gas current, and it would be a mistake to altar the flow, since after boiling begins the ascending bubbles resume their original rate. After more than three minutes the first indications of the formation of a precipitate at the lower end of the delivery tube are observed. The precipitate, which is at first coarsely flocculent, gradually becomes crystalline, and does not usually show any apparent increase after eight or ten minutes. Nevertheless, it is better to allow the liquid to boil for twenty minutes, so that the last traces of methyl iodide may pass over into the receiver.

The operation is concluded by removing the burner, raising the apparatus so that the lower end of the delivery tube reaches into the empty wider portion of the receiver, removing the cork stopper from the water seal, and rinsing the delivery tube with water, first outside and then from above with a sharp jet from the wash bottle. Should a few particles of silver iodide still adhere to the delivery tube, this is again rinsed with a few drops of alcohol and then once more with water. By alternately rinsing with alcohol and water, all adherent particles of precipitate are readily removed with the help of the surface tension effect, provided that the glass surface was originally clean and free from grease. Should a particle of any size be obstinately retained at any point it can be successfully removed by using the feather. The contents of the receiver are diluted by the washings, so that their final level is at about the middle of the widened portion. After adding five drops of concentrated nitric acid free from halogen, the receiver is placed in a gently boiling water-bath until the contents begin to boil. The use of more nitric acid should be avoided, as glyoxal is otherwise formed, which may give rise to methoxyl values which are too high on account of its relative insolubility. It should be expressly noted that it has been found quite unnecessary to evaporate the alcohol as recommended for macroanalysis, and that, after warming for one or two minutes, the silver halide double compound is completely decomposed. After cooling under the tap, or in a beaker filled with cold water, the seperated silver iodide is aspirated into a filter tube and weighed.

Here are two analytical results of this micro determination: a) gravimetric method in the absence of sulphur for vanillin: theory 20.40 per cent OCH_3 — actually found 20.37 per cent. b) gravimetric method in the presence of sulphur (potassium sulphate was added) for vanillin: theory 20.40 per cent OCH_3 — actually found 20.43 per cent.

Special chemicals for micro-analysis can now be obtained from Eimer and Amend; they are listed on page one-fifty-eight of the catalog of Chemicals and Drugs 1931.

CHEMICAL AFFINITY.

REV J. J. SULLIVAN S.J.

Chemical affinity! One of the most inviting and yet one of the most elusive concepts in the realm of science. Why an atom of oxygen has such varied and such insatiate appetite for combination. Why the carbon atom forms hundreds of thousands of compounds. Why argon and helium and neon and krypton are bachelor atoms. Why T. N. T. explodes with such violence. Why SiO_2 is so stable. These and a hundred other questions we could ask ourselves. And all of them could be answered so readily if we had some sort of clear notion of the meaning of "Chemical Affinity."

Passing by the picture presented by certain Greek philosophers that the elements combined because of "love" and repelled each other because of "hate", passing by the mechanical notion, also proposed later on, that combination was the result of hook-like devices on the atoms, and the electrical explanation suggested at the beginning of the 19th century whereby affinity was resolved into an electrostatic phenomenon, we come to the first quantitative attempt to explain "affinity" in the papers of Berthelot and Thomsen around the middle of the last century.

Berthelot figured that the heat given off when a chemical reaction took place was like the sparks given off when a tool was pressed on an emery wheel. Such heat meant business, and the greater the heat the greater the reactivity, the greater the affinity. He measured the Heat of Reaction for a host of accessible reactions, and from the data compiled a table of affinities. For instance, when Potassium combined with Chlorine, the heat given off was greater than when Potassium combined with Bromine and this in turn was greater than when Potassium combined with Iodine. So, his conclusion was that Potassium had the greatest affinity for Chlorine, less for Bromine and least for Iodine, and (he stated) in a competition between Chlorine, Bromine and Iodine for Potassium, the Potassium Chloride, reaction would have the preference. As a result of these measurements (we shall not discuss their precision at this writing) Berthelot proposed his so-called Third Principle of Thermodynamics, namely: "Every chemical change which takes place without the aid of external energy tends to form the substance or system of substances which evolves the most heat".

Though this principle seems to explain some of the questions of chemical affinity, and actually did hold sway for some time, it is fundamentally false, because according to this law only exothermic reactions are possible. Yet we are familiar with several endothermic reactions. Besides, many reactions may be carried beyond the equilibrium point and be reversed. Thus, one way they are exothermic, and the other, endothermic. And the heat of reaction is the same—but for a change in sign. So, combination and decomposition—with the same heat effect—are possible with a slight change in the concentration of the materials involved.

As an example, let us take the dissociation of Hydrogen Iodide into Hydrogen and Iodine. The reaction is endothermic

$$2HI = H_2 + I_2 - 12,000 \text{ cal.}$$

According to Berthelot this should not take place, yet it can take place, and the reverse reaction, also, provided we have a closed system and can change our concentrations at will.

To explain our modern picture of affinity, we have to call on the somewhat recent science of Thermodynamics to aid us. According to this system, every reaction can be pictured as reversible, and each can be considered under conditions under our control as reaching some sort of an equilibrium. The equilibrium between reaction and products can be represented by a pendulum at rest—or swinging equally towards and away from its zero point. If we raise the pendulum away from it's zero point, we give it a certain potential. If we raise it farther, we increase the potential. If we raise it very far, we give it a very great potential. So, if we change the equilibrium concentrations of a reaction, we can give the reaction a greater or less potential, (or driving force) depending on the way we vary the concentrations. Because by this change we get farther (more or less) from equilibruium. And this distance from the equilibrium-point, or potential, is a measure of the driving force of the reaction. Hydrogen, Oxygen and Water reach an equilibrium around 2000° C., with the balance in favor of the water vapor molecules. However, at 2000° C., water molecules decompose into Hydrogen and Oxygen molecules if the pressure of the water molecules is sufficiently great. That is, if the driving force is great enough in the direction of dissociation. That is, if the equilibrium is displaced sufficiently in the direction of the water molecules. Then, these spontaneously decompose into their constituents. So, any reaction may be made to go forward or backward, thus reversing the affinities involved, provided we control the temperature and concentrations of the reactants.

A numerical statement of such a condition has been proposed by Thermodynamics in the concept of Free Energy. This is a measure of the Maximum Work of any process which is carried on reversibly, and is a measure of the distance of the "pendulum from the point of equilibrium." Equilibrium for the following reaction is expressed mathematically:

$$\text{When } aA + bB = cC + dD$$

$$\text{Then } \frac{C_C^c \cdot C_D^d}{C_A^a \cdot C_B^b} = K \text{ equil.}$$

As is evident from this formulation, reaction towards the right depends on an excess concentraion of the reactants, and reaction towards the left on an excess concentrations of the products. So we could have positive and negative "affinities". We could have the same substance stable and unstable—provided we could control conditions sufficiently. Thermodynamics has settled the question by calling the driving force of a chemical reaction Free Energy Decrease, designated by $-\Delta F$, and the complete expression of this measure of affinity is

$$-\Delta F = RT \left(\ln K - \ln \frac{C_C^c \cdot C_D^d}{C_A^a \cdot C_B^b} \right)$$

To derive this expression would take us too far afield for the scope of this paper, but it will be evident from a little consideration that this expression pictures the "pendulum away from its equilibrium point". *Ln K* is the "equilibrium constant". *Ln* of the other concentrations tells the direction of the driving force of the reaction. This equation gives us a measure of the elusive and inviting concept of chemical affinity. And, on a bit of examination, it answers many questions we have been waiting long to ask.

CHEMICAL PROBLEMS AWAITING SOLUTION.

Rev. G. F. Strohaver, S.J.

The Periodic Table, despite the great advance in our knowledge of the factors which underlie it, still presents a number of peculiarities for which no explanation is available. Outstanding are the following:—

1. No obvious reason is furnished for the abnormality of Boron. Boron is trivalent in its hologen compounds, but quadrivalent in its hydrogen derivatives. It is true that the magnetic model atom of Marsh and Stewart offers a suggestion that the nuclear constructions of boron and carbon may be analogous to each other in certain respects; and possibly this factor may play some part in the problem: but at present nothing definite is known with regard to the origin of the boron peculiarities.

2. The behavior of glucinum and magnesium seems to require an explanation. With the exception of the Zero Group and Group VIII, the families of the Periodic Table are subdivided into two sections, to one of which the pair of elements in the first two series can be attached without too much difficulty; but Group II is split up into three sections: glucinum and magnesium; the alkaline earths; and the zinc-cadmium-mercury triplet. For example, although all the alkaline earth metals form hydrides, no such derivatives of glucinum and magnesium have been obtained; on the other hand, both these metals yield alkyl derivatives. This behavior suggests a resemblance to the zinc-cadmium-mercury triplet; but when an attempt is made to

trace this alliance further into the chemical properties of the substances, it fails owing to the marked differences which come to light at once, as any text-book of analytical chemistry will show.

3. The halogen group presents an unsolved problem when the combination between its members and oxygen is examined. Why do fluorine and bromine yield no oxides, while chlorine and iodine each give rise to more than one oxide? Fluorine and bromine belong to the first short and first long series respectively, whilst chlorine and iodine are members of the corresponding second series; and possibly this may have some connection with these chemical peculiarities; but the fluoride has not yet been obtained.

4. Thallium is one of the greatest troubles in the Periodic System, owing to the similarities in behavior which it displays with regard to elements situated far away from it in the tabular scheme. None of these is justified by its place in the table.

5. An interesting problem presents itself when the Table is looked at in a broader manner. The main characteristic of the Periodic Table is, to state a truism, that it is a periodic arrangement. Now the sequence of the atomic numbers is simply the sequence of successive integers, and this, of course, shows no signs of periodicity. The family relationships of the Periodic Table, then, have no direct connection with the atomic number—i. e., with the atomic nucleus. Therefore the origin of the periodicity must lie in the outer sphere of the atom, as is assumed in the modern atomic theories. But atomic volume is a periodic property, as can be seen from the ordinary Lothar Meyer curve of atomic volumes. Therefore the atomic volume must be controlled by the nature of the outer sphere of the atom. This is an inference of no little interest, since the atomic volume variations correspond to the variations in many physical properties of the elements. The fact that the atomic volume seems to be a natural constant — since it is the same for all isotopic atoms — suggests that some thought expended upon this matter might yield results of interest.

6. No explanation has been offered for the fact that lead forms the end-point upon which all the radioactive series converge. The element lead is not the upper limit of atomic stability, since bismuth has a higher atomic weight and yet is perfectly stable; nor is lead the lowest element in the radioactive group, for radioactive isotopes of thallium are known. There must be some reason for No. 82 being, so to speak, the dumping ground for the residues of radioactive change; but so far the cause of the phenomenon has escaped us.

7. While the isotopes are numerous, the isobares are comparatively rare; and no explanation of this has been suggested.

8. The inter-relationship between surplus nuclear charge, the system of outer electrons, and the chemical properties of atoms appears to be a subject which will repay consideration in the future, for already it is possible to note a number of interesting points which await solution. The influence of the surplus nuclear charge can be seen by

considering cases of systems which may be designated as iso-electronic, since they contain an equal number of electrons. For example, the isabaric atoms of argon, A-40, and calcium, Ca-40, both contain a total of 40 electrons; but since they differ in chemical individuality, it is clear that the chemical nature of the atom does not correspond to the total number of electrons in the atom. Further the argon atom A-40 and the calcium ion derived from Ca-40 both contain 18 electrons in the outer sphere; and yet they differ in chemical individuality: so that evidently chemical individuality does not reside in the outer zone of the atom. This leaves only the nucleus as the origin of chemical nature. But chemical individuality and X-ray spectra are believed to go hand in hand; and yet the X-ray spectra are supposed to take their rise in the outer sphere of the atom. We know that the ordinary emission spectrum of hydrogen is apparently the same as the X-ray spectrum of the element; and if Bohr's views be adopted, this spectrum must have its origin in the single electron of hydrogen atom. But this electron is obviously an "outer sphere" electron, since it is removed from the atom on ionization. Thus there seems no escape from the inference that chemical individuality and X-ray spectra go hand in hand and yet originate in different parts of the atomic structure.

MATHEMATICS

The Axioms of Mathematics.

Rev. F. W. Sohon, S.J.

In definitions and demonstrations, if vicious circles are to be excluded, there must obviously be ultimately undefined terms and unproved prepositions. The *petito principii* that these apparently involve might be avoided if the undefined terms expressed primitive concepts knowable by immediate intuition, and the unproved propositions were evident by immediate intellection. Such was for a long time presumed to be the case. But presumption and truth are disparate. The fundamental concepts of mathematics, or at least some of them, turned out to be neither primitive concepts nor intuitive, and some propositions presumably self-evident, showed themselves to be false. A presumption is a prudent risk in the absence of information, but a presumption cannot lie at the foundation of a science unless we are disposed to accept a philosophy of pragmatism. We are fortunate, however, in that we do not have to choose between a presumption of truth and a presumption of uncertainty, for the latter alternative is worse than the former. There is still a third possibility which is not to make any presumption at all, but to build up our science hypothetically, contingent upon the unproved propositions concerning the truth of which we have suspended judgment. In accordance with this point of view the unproved propositions are no longer called axioms, but the more appropriate term of postulate is employed instead. The body of postulates will be called a postulate system.

If in the postulate system, each defined term is replaced by its definition, it is theoretically possible to express them in terms of the so-called undefined terms alone. In the absence of any presumption as to the nature of these undefined terms it neither follows that they are meaningless nor that their range of signification is indefinite. Clearly they can represent only those entities that are connected by the set of relations postulated in the unproved propositions, but can represent, therefore, universal concepts whose essential notes are given by the postulate system. They are not really undefined, for the unproved propositions really define and limit them. What we are really doing, then, is to make a study of a given set of relations in the abstract, and this is surely a legitimate field for scientific investigation.

The body of propositions deducible from a postulate system is called the implication of that system, and in so far as it is formulated constitutes a development of the postulate system. If nothing can be deduced from a given postulate system, as for instance would be the case if the postulates were all negative or all particular, then the postulate system is called incompetent. If the postulates are inconsistent, then *a fortiori* the system is incompetent. We naturely concern ourselves only with the investigation of competent postulate systems. If one of the postulates can be deduced from the others, then the implication of the system will not be changed by dropping such a proposition. We may suppose all such propositions dropped from the postulate systems under discussion. There will usually be a choice as to what proposition can be dropped, so that we must recognize the fact that different postulate systems may have the same implication. Postulate systems having the same implication are said to be equivalent.

We are drawing an analogy from analytical geometry. We show the position of a point with respect to a competent reference system or set of axes. The choice of reference system is arbitrary. We are thinking of a postulate system as a reference system in a development, and the choice between equivalent postulate systems will be arbitrary. Corresponding to the comprehension and extension of a concept, we can speak of the implication and application of a proposition. We use the syllogism to show that the implication of the conclusion is contained in the combined implication of the premises. A logical demonstration, therefore, consists in showing that the implication of an assertion is contained in the implication of a given postulate system. Such a demonstration is called relative in the sense that it relates a logical entity to a given logical reference system.

When we use co-ordinate systems to solve a problem in physics the important physical entities are independent of our choice of reference system. As a matter of fact they are what are called invariants. There is a smilar thing as regards implications. The implication remains invariant when a postulate system is replaced by an equivalent postulate system. But suppose that two postulate systems are not equivalent. There is a possibility that their implications may have something in common. There is a possibility that all competent postulate systems may contain at least a certain minimum implication in common. We should then have an implication that is independent of any given postulate system, for no matter how we replace the given system by any other competent system, the invariant common implication of all competent postulate systems would still be implied. If this implication is formulated into propositions, then the propositions themselves will necessarily be found in the development of every competent postulate system, and all will be called necessary propositions, in contradistinction to other propositions that may be found in one development and not in another, and which will be termed contingent propositions.

If it can be shown that a given proposition is a necessary proposition, that is to say, that it is implied in the invariant common implication of all competent postulate systems, then it will be shown that the given proposition is logically independent of any particular choice of logical reference system, it will be shown that the logical position of the given proposition is not related to, but independent of any particular set of premises that allow ratiocination to be possible. When we show this about a proposition, we call it an absolute demonstration in contradistinction to the ordinary or relative demonstration. Absolute demonstration is a process of induction by which it is shown that the assumption of a certain proposition was necessary, and therefore not arbitrary, and therefore not gratuitous.

Absolute demonstration is theoretically possible. If by adding the contradictory of a proposition to a given postulate system, we render the system logically incompetent, we know that the proposition itself is contained in the implication of the given postulate system. The denial of the principle of contradiction, for example, clearly makes every possible postulate system incompetent. It is certain therefore that an invariant common implication of all competent postulate systems exists, and that therefore some propositions are necessary and some are contingent. But it does not fall within our province to give absolute demonstrations nor to formulate a body of necessary propositions. If it be objected that absolute demonstration proves the logical necessity of a proposition and not its truth, we reply that a distinction between logical necessity and truth can only be pertinent in a science that admits psychological as well as ontological reflection. It is therefore a matter for the logician to ponder. Logical necessity is a firm enough cement for mathematics.

The effect of adding to our list of premises a new proposition which, though not deducible from the given postulate system, is yet consistent with them, is to narrow the range of possible interpretation of our so-called undefined terms. The development is specialized, becoming more particular. For example, if to the geometrical postulates there is added the further postulate that all points are coplanar the subject is contracted (in application) to plane geometry. The extra postulate may be embodied in a definition, because in mathematics as we have seen a postulate is a partial implicit statement of the signification of an originally undefined symbol, whereas the mathematical definition is an explicit statement of the signification of a symbol to be introduced.

For example in the discussion of conic sections one might develop part of the subject with the postulate that the eccentricity is unity. But it is less confusing to call a conic with unit eccentricity a parabola and to talk about parabolas. The only question is whether the complication of the terminology caused by the new definition is compensated for by a proportionate simplification of the development. Where the diminished application of the postulate system due to the addition of the new postulate can be accounted for by the decrease of extension of a single concept, it would seem that a definition is called for provided that the new development is of any importance. But if the term will be little used it might be better to economize since words are scarce.

By dropping a postulate from a system of independent competent postulates, the implication is decreased and the application increased, and this means that a corresponding change takes place in the otherwise undefined terms. One or more of them must have its or their comprehension decreased and extension increased. This process is generalization. Here again the question comes up as regards a new definition. For example, if we drop the principle of mathematical induction from the arithmetic of cardinal numbers, should we still call the generalized entities cardinal numbers? It is dangerous. Perhaps most philosophical muddles take their root in hasty and ill-understood generalization and the resulting tangled terminology. Hence it seems to me that a generalized term, especially if little used, should be well marked as such. If the generalized term is to be more used than the inferior from which it was derived, the term may be transferred and the inferior consistently marked with its specific difference. Examples of the latter will be found in the philosophical generalization of cause from the notion of efficient cause, and the physico-mathematical use of the word dimension to designate any independent quantitative determinant of a body, an obvious generalization of the less important space-dimension.

It need hardly be pointed out that only contingent propositions can be dropped, and that all the necessary propositions must be retained intact. But is there any other limit? The prevailing opinon seems to be that when all but the necessary propositions have been dropped we have passed out of the realm of mathematics into the realm of dialectics, and that dialectics, and mathematics are essentially the same. In other words, when dialectics becomes complicated it is called mathematics, and the only question is where the artificial and purely arbitrary barrier is to be set up between the two subjects. I am afraid, however, that this view comes from attaching too much importance to the rules for the syllogism with the moods and figures, all of which is certainly mathematical in spirit if not applied mathematics in fact, but which with equal certainty is not the most representative part of minor logic. In logic we are concerned with propositions as expressions of operations of the mind and in their relation to the thinking subject. In mathematics the subjective element is elimated. The two subjects differ in their formal object, and therefore it seems unnecessary to fence off the material object.

Besides adding a postulate and dropping a postulate, the postulate system may be revised by replacing a contingent proposition with another which may or may not be its contradictory. This may be employed as a device to test the independence of the original postulates. It may, however, be generalization or specialization in disguise. This will be detected if there is a change in the extension of a concept, or a change in the range of application of a proposition, as for example when the laws of exponents are extended to cover the case of a zero exponent. In general, however, the replacing of a contingent proposition gives rise to a new development which parallels the old with interesting differences. The development of non-euclidean geometry is an example of this.

The example is of sufficient importance to merit a brief discussion. The replacement of the parallel axiom can be discussed both *a priori* and *a posteriori*, and it is important to keep the discussions separate. To object *a priori* to dropping this axiom, one must make the contention that it is a necessary proposition, expressing part of the invariant common implication of all competent postulate systems, and to be really consistent one should take up the position of Kant that not only this property, but all other properties of space and time are knowable *a priori* antecedent to experience. But if the position of the objector is hard to maintain, the position of the defender is especially strong in the *a priori* argument. The effect of adding the contradictory of the parallel axiom to the other postulates in place of the parallel axiom itself does not render the postulate system incompetent. Many have worked for centuries on this without finding any contradiction. More than this, non-euclidean geometry can be derived from Euclidean by definition instead of postulation. In other words, a set of entities can be defined in terms of the undefined terms of Euclidean goemetry, so that it can be proved that the non-euclidean postulates will hold for these entities when and only when the Euclidean postulates hold for the undefined terms of Euclidean goemetry. Consequently if a contradiction should be found in non-euclidean goemetry, then by substituting for each non-euclidean entity its definition in terms of Euclidean elements, we should also have a contradition in Euclidean geometry. From this we conclude that the parallel axiom is not a necessary but a contingent proposition. The only approach to the question is therefore *a posteriori*.

The *a posteriori* discussion is out of place here except in so far as it supplies an existence theorem. It is not known with certainty whether the three space-dimensions contain a geometry that is Euclidean when the notion of distance is taken as empirically defined by the rigid body to which solids approximate. It is certain however, that in solving problems in mechanics the four dimensions length, breadth, thickness and duration cannot be all treated alike and interchanged at pleasure. Hence the four dimensional goemetry that is involved is certainly non-euclidean. We therefore stand in the position of knowing that at least one system of non-euclidean goemetry is exemplified in the physical world, but of not knowing with certainty whether there exists any system in the physical world for which the postulates of Euclidean goemetry are valid. This serves to bring home our contention that if some of the unproved propositions of mathematics are necessary, some are also contingent, and the properties of space and time are not therefore knowable *a priori* antecedent to experience.

PHYSICS

A Modification in the Pendulum Experiment.

George P. McGowan, S.J.

It may be of interest to Ours, who are engaged in laboratory work in physics, to learn of a modification in the Coincidence Pendulum Experiment as performed in the Georgetown Laboratory. The method, employed here as elsewhere in our colleges and high schools, makes use of two pendula, one approaching the simple pendulum, the other a physical or compound pendulum. By comparing the vibrations of the latter with those of the former, thus determining which of the two has the longer period, and then noting the coincidences when both are swinging simultaneously, the value "T" is determined and may be substituted in the formula $g = \frac{\pi^2 l}{T^2}$

In doing the experiment, it is customary to note the time of 500 vibrations of the compound pendulum by means of careful attention to the swings and with the aid of a stop-watch. This step has been simplified and greater accuracy attained by connecting into the circuit a telachron. This modification consists of a small synchronous motor, run by dry cells. A clock-face arrangement is attached to the motor and the metal hand makes sixty revolutions per min. During every revolution, the hand comes in contact with a metal connection to the circuit of the simple pendula. These pendula, of course, are connected in parallel and to every one is attached an earphone. At present we have six in the circuit and the results are very satisfactory. The telachron is kept in the office of the department, and those engaged in the experiment are given an opportunity of inspecting it at the beginning of the laboratory period. In order to check up on the accuracy of our telachron, we will make use of the chronograph which has recently been added to the equipment of the Georgetown Physics Laboratory.

"A CALENDAR OF PHYSICS EXPERIMENTS".

Rev. J. A. Tobin, S.J.

Among the things listed long ago as the things which seemed to him most needful for the Advancement of Learning, Francis Bacon mentioned A Calendar of Leading Experiments for the Better Interpretation of Nature.

To make such a calendar for Lecture Table Experiments, as the Manual is really a calendar for the Laboratory Experiments, we used our notes taken at the Lectures of Father Brock at Woodstock. Then through the kindness of Mr. Bernard Fieckers at Weston we received many helps from Father Brock.

There are many lacunae in this calendar. There are many experiments that need a longer explanation. But the list is given as a suggestion for discussion. If the teachers would correct it and add to it, we could make a complete list next summer.

1. MECHANICS.

1. Measurement. Exhibition of measuring apparatus to prepare the class for the first laboratory experiments.

Length. a A large wooden model of vernier.

b Model of Micrometer screw. Spherometer.

c Level testers, optical lever.

d Comparators and micrometer microscope.

Mass e Balances, Chemical, Chainomatic

Time f Stop watches.

2. Motion of Translation. Laws of Motion.

a Cars, pulley and weights (Fr. Wulf) Fig. 8.

b Inertia, — card under ball.

c Each force has own effect, — A gun operated by a spring projects a ball out in front and simultaneously drops a ball on the floor.

d Action and Reaction, — Two large dynamometers pulled by two men and forces read. Impact pendula.

3. Vectors and Composition and Resolution of Vectors.

Large graph board and dynamometers. Force Table. Models of airplanes.

4. Motion of Rotation, Torque, Centrifugal Force.

a Centrifugal Force.— Two hoops crossed that flatten in rotator. Globe of mercury and water. New Cenco unit for measurement of force. Centrifuge. Centrifugal control. Ring and chain that take horizontal plane. Loop the loop.

b Torques. Principle of Torques. Large graduated bar with movable weights and suspension.

c Conservation of angular momentum,— Rotating table and student sitting on it. If large weights are held out and then pulled in, change of angular velocity.

d Gyroscope. Sperry Model to show stabilizer, automatic control etc. Large bicycle wheel with a very heavy rim.

5. Periodic Motion.

a A large ball suspended is swung around in a circle. A parallel beam of light projects plane of circle on screen.

b Jolly Balance, — spring with weights.

c Tuning fork with mirror. As fork vibrates and is moved through angle beam of light reflected from mirror takes form of harmonic curves.

d Simple Harmonic Machine. Kaleidophone.

6. Gravitation.

a Feather and coin tube. Water Hammer.

b Acceleration Machine. Law of falling bodies explained by curve traced on waxed paper.

c Two tracks, one straight, other cycloid and marble.

7. Pendulum and Principle of Resonance.

a Three pendula of lengths 225 cm., 100 cm., and 25 cm.

b Large iron ball as bob and magnet to show change of "g"

c Baseball bat in frame, — center of percussion.

d Kater Pendulum and Coincidence Pendula explained.

e Moving pictures of Foucault's Pendulum at Weston College.

f Principle of Resonance,—Two pendula of same length and one of different length fastened to strong string between supports. Two Tuning forks of same period.

8. Centre of Gravity and Equilibrium.

a Three triangles differently weighted and suspended from three vertices.

b Cone or doll with weights on each side stands on point.

c Cone in three positions. Leaning Tower. Humpty—Dumpty doll.

9. Friction.

Inclined plane and plane surfaces, cars, rollers etc.

Moving picture of four men pulling big locomotive that has ball bearings.

10. Machines.

a Levers. Scissors, nut cracker, candy tongs etc.

b Windlass model. Models of gears.

c Model of jackscrew.

d Various combinations of pulleys.

e Inclined plane, car weights etc.

11. Elasticity.

Laboratory experiment. Exhibition of apparatus.

12. Pressure of Liquids.

a Pascal's syringe and Pascals Vases. Hydrostatic paradox.

b Soap bubbles are not square etc.

c Water seeks own level in tubes of various shapes.

d Model of Hydraulic Press.

13. Buoyancy of Liquids.

a Large balance, brass bucket in which brass weight fits. Immerse in liquid and pour liquid in bucket.

b Brass ball in water and mercury. Eggs in water and salt solution. Hydrometers.

c Cartesian diver.

d Measure of Density. Exhibition of Hare's method, Jolly Balance, Mohr Westphall Balance etc.

14. Pressure of Gases.

a Magdeburg Hemispheres.

b Rubber broken over bell jar. Mercury filters through wood.

c Torricelli's tube, large bell jar for tube.

d Explanation of Fortin and Aneroid Barometers and Barograph.

e Balloons expand in bell jar.

f Boyles Law apparatus explained.

g Models of syphons and pumps.

h Cup of Tantulus. Water fountain.

i Trick bottle. Three compartments with holes on side that control flow of different liquids.

15. Molecular Phenomena.

a Surface Tension. Surface tension ring. Silk loop in soap bubble mixture. Skeleton frames in soap solution. By vertical projection show drop of alcohol between two small particles of wood. Drop some clean camphor in water and project on screen. Needle floats. Measure by Chainomatic balance.

b Capillary Phenomona,— Two clean plates, Elevation in tubes.

c Brownian Movements. Small box with smoke in it under microscope.

16. Fluids in Motion.

a Atomizer. Ping-pong ball in stream of water or air.

b Spool and card. Stream lines in airplanes.

c. Langmuir diffusion pump.

(Heat and Sound to follow.)

SEISMOLOGY

WHY SELECT THE GALITZIN-WILIP VERTICAL?

(Paper read at Cleveland meeting, Jesuit Seismological Association.)
December 28, 1930.

REV. J. P. DELANEY, S.J.

To review the advantages and limitations of this or that type of seismometer is not the objective of the present paper. It is proposed to state only the reasons that determined the selection of the Galitzin-Wilip Vertical Component instrument for the Canisius College observatory when authorization was given a little over a year ago for the installation of new equipment.

The best and latest types of seismographs were carefully surveyed, both those of American and foreign construction. The fine Wood-Anderson torsion seismometers, both the long-period and the more recent short period, were carefully inspected at St. Louis and Florissant. The Milne-Shaw instruments and records were studied at Fordham and at Toronto. Some Milne-Shaw records of Harvard were reviewed. The new seismometer of Dr. Wenner was inspected at the Bureau of Standards, and an interview with the distinguished inventor emphasized the validity of the new principles applied in this latest addition to the seismometer family. The Cambridge-Paul Galitzins were studied at Georgetown under the inspiring tutelage of Father Tondorf, and a display of Georgetown seismograms at the National Academy of Sciences left a profound and indelible impression in favor of the Cambridge-Paul Galitizin. Finally the Galitizin-Wilip instruments were examined at Fordham and at Florissant, and the records obtained from these modified Galitzins were found to be no less impressive than the records from the heavier Georgetown Galitzins. Thus the best and latest seismographs were studied and their various records were compared. Other types such as the Bosch-Omori, the Mainka, the heavier Wiecherts, were thought of, but these were given less detailed consideration.

The selection of a seismograph is determined within very narrow limits by the prime purpose for which it is intended, by the locality and limitations of the observatory, and by the type of vault available or to be built to house the instrument. Even the prime purpose of an observatory must be qualified in view of these latter limitations of locality and vault construction. An observatory projecting the study of ground tilting, or the study of slight local tremors, could not be set up in the basement of a building bordering on a main traffic artery. Wall tilting would vitiate the study of ground tilt, and traffic vibration would vitiate the study of slight local tremors. The seismograph vault at Canisius College is subject to these limitations. The construction of a new vault would far exceed our present resources, and even a new vault built below ground, away from the main building to escape wall tilting, would still be subject to heavy traffic vibration. The Canisius vault is directly beneath the main front wall of the building. This wall faces the afternoon sun, and it is only two hundred feet from Main Street traffic where flows an incessant stream of business, trucks, and heavy interurban street cars. These conditions were considered as precluding the usefulness of any type of direct-reflecting seismometer. Thus both the long and the short period Wood-Anderson instruments, as well as the Milne-Shaw, were dropped from consideration.

The only instruments considered available, in view of our vault limitations, were those using the galvanometric system of registration. In this class three types stand out prominently, the Wenner, the Galitzin of Cambridge-Paul, and the Galitzin-Wilip. The Wenner is a superb little instrument, rugged and simple, using no damping system beyond the simple reactance of the induction magnets and galvanometer. This instrument was seriously considered for our Buffalo observatory. One circumstance alone deferred for the present the acquisition on a Wenner—the vertical Wenner had not yet appeared—in fact that with our Wiechert we were already equipped with the two horizontal components and that we were without a single vertical instrument. Commander Heck on several occasions has deplored publicly America's paucity of vertical instruments. On a visit to our Canisius observatory he expressed regret that we were without a vertical component. Pressing closely on these urgent appeals of Commander Heck, a very impressive fact was noticed by the writer, namely that observatories equipped with the three components published in their bulletins more numerous readings from their vertical instruments than from either of the other two components.

These three reasons, then, decided our selection of the Galitzin-Wilip Vertical, namely our observatory was already equipped with the two horizontal components but was without the vertical, Commander Heck strongly advocated the addition of a vertical instrument, and lastly, stations equipped with vertical and horizontal instruments of the same order of sensitivity gave evidence of having found greater usefulness in their vertical instruments.

As between the Cambridge-Paul Galitzin and the Galitzin-Wilip the choice was rather economical than scientific. The Cambridge-Paul was quoted at an enormous figure while the Galitzin-Wilip was found to be within reasonable reach. It was found too that the pier already available in our vault for a new instrument, reaching down to a solid rock foundation of cherty limestone, was large enough for the

Galitzin-Wilip, but it was considerably too small for the larger Cambridge-Paul seismometer.

The happy choice of the Galitzin-Wilip has been more than justified by the successful results obtained during the first six months of operation. Building vibrations, large temperature changes, and excessive building tilt have produced no noticeable effect on our seismograms, whereas such disturbances would have caused much trouble with all other types if indeed they could be operated at all.

SEISMIC LINES IN THE PHILIPPINES.

REV. W. C. REPETTI, S.J.

In 1913 Father Saderra, in collaboration with Dr. Smith of the Bureau of Science, drew up a map of the Philippines showing the seismotectonic lines of the archipelago.

At that time accurate seismographic data were very limited and the authors were necessarily guided, to a great degree, by physiographic features and verbal reports of earthquakes. Since that time Father Saderra has drawn up a map showing the seismic areas with the number of earthquakes of each area. This is but a very general representation of conditions.

Good seismographs were installed in Hong Kong and Taihoku about 1920 and in Phu-Lien, French Indo-China, in 1925.

Now that more accurate material is available it seems desirable to locate earthquake epicenters more definitely. With this end in view the writer commenced several months ago with the earthquakes of northern Luzon for the ten years period, 1920-1929. The epicenters of 35 earthquakes were determined, 28 of which were submarine. The epicenters of these latter fall in four definite lines; three of which are approximately parallel to the west coast and Luzon, and one east-west in the Balintang Channel north of Luzon. The three lines off the west coast are about 50 km. apart. These lines coincide with the Deeps off the west coast and the U. S. Coast and Geodetic Survey officials have indicated their willingness to run profiles across the Deep with the fathometer at the first favorable opportunity. This is a definite advance in our knowledge of seismic conditions at the north end of the Philippine archipelago.

The above work will be published in detail in a future number of the semi-annual seismological bulletin of the observatory.

BOOKS

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

Astronomy.

Astronomy: A Text Book, Second revised edition. J. C. Duncan, Harper & Brothers, New York.

Astronomy: An Introduction, R. H. Baker, D. Van Nostrand Co., Inc., New York.

Biology.

Guide to the Study of Histology and Microscopic Anatomy, A. E. Lambert, P. Blakiston's Son & Co., Philadelphia, Pa.

A Compend of Bacteriology, 5th edition, R. L. Pitfield, H. Schaffer P. Blakiston's Son & Co., Philadelphia, Pa.

Recent Advances in Plant Physiology, E. C. Barton-Wright, M. Sc., London, P. Blakiston's Son & Co., Philadelphia, Pa.

Principles of Functional Anatomy of the Rabbit, E. D. Crabb, P. Blakiston's Son & Co., Philadelphia, Pa.

A Textbook of Laboratory Diagonsis, E. E. Osgood, M. D. P. Blakiston's Son & Co., Philadelphia, Pa.

Chemistry.

Treatise on Physical Chemistry, Twenty Contributers
Edited by Hugh S. Taylor, D. Sc., D. Van Nostrand Co., Inc., N. Y.

Quantitative Pharmaceutical Chemistry, G. L. Jenkins, McGraw—Hill Book Co., Inc., New York.

Rapid Methods for the Chemical Analysis of Special Steels, Fourth edition. C. M. Johnson, John Wiley & Sons, Inc., N. Y.

General Chemistry, Third edition. H. G. Deming
Exercises in General Chemistry, Third edition. H. G. Deming, John Wiley & Sons, Inc., N. Y.

Reactions and Symbols of Carbon Compounds, T. C. Taylor, Ph. D., The Century Co., New York.

Recent Advances in Physical and Inorganic Chemistry, Sixth edition. A. W. Stewart, D. Sc., Univ. of Belfast. Longmans, Green Co., N. Y.

Recent Advances in Analytical Chemistry, Vol. I. Organic Chemistry. C. Ainsworth Mitchell, M. A., P. Blakiston's Son & Co., Phil., Pa.

BOOK REVIEWS.

ASTRONOMY: A TEXT BOOK, by John Charles Duncan. Second Revised Edition. Harper & Brothers. $3.75.

ASTRONOMY: AN INTRODUCTION, By Robert H. Baker. D. Van Nostrand Co. $.375.

These are two text books which have appeared within the past few months. Both are excellently illustrated, and are up to date, containing the latest developments in the field of astrophysics. The work of Professor Baker, of the University of Illinois, is non mathematical in character and well suited for the ordinary course in descriptive astronomy as given in our colleges. As was stated in a review of the book in "Popular Astronomy", the volume treats equally well all branches of astronomy, and if the author has any particular hobby in the science, it is not evidenced by over-emphasis of the hobby in the writing of the book. It is a well-bound book, able to stand the rough treatment which is the common lot of college text books. The paragraphs are numbered according to a decimal system, that is, the first figure is the number of the chapter, the rest, the number of the paragraph in that chapter. The illustrations bear the same number as the paragraphs which they illustrate. I do not consider the division of the index into two sections, names and subjects to be an advantage. Too frequently one looks for a subject in the index of names and vice versa.

The volume by Professor Duncan, of Wellesley, treats the subject more fully than does Baker, but goes too far afield in proving propositions from physics and other subjects. For students who have had a good course in physics, the explanations are unnecessary, for the others they are out of place and can be omitted without sacrificing clearness in the exposition of the astronomical concepts. The illustrations are of a very high order. I believe that the book is a little too advanced to be a text book in our ordinary college courses, though on account of the fuller treatment it is admirably suited as a reference work for students who wish to delve a little more deeply into astronomy. My principle objection to the book, however, is that the author does not confine himself strictly to the field of astronomy, but allows himself to be influenced by a strong theological bias, by the moth-eaten Galileo bogey, and by an extremely pessimistic view of man's place in the universe. The following excerpts are particularly objectionable, especially in a "second edition revised":

(1) "Tycho took a backward step in theoretical astronomy by rejecting the Copernican system, partly on theological grounds and partly because his most careful observations failed to show any parallactic displacement in the stars." P. 201.

(2) "In his old age Galileo was tried by an ecclesiastic court composed of men who, no doubt, were pious and conscientious, but to whom the idea of the Earth's not being the immovable center of the universe was so repugnant that they convicted

Galileo of heresy, and he escaped severe punishment only by publicly abjuring the belief that he knew to be true. Forty years earlier, Giordano Bruno had been burned alive for similar heresies." P. 202.

(3) "Not so very long ago, man regarded himself as the center and crowning glory of the universe.................. Man has lost his exalted position not only in space but also in time. It appears that the stars existed millions of millions of years before the Earth was born; that it was thousands of millions of years later that terrestrial life began at the shore of the primordial sea; that hundreds of millions more elasped before man appeared; and that during all but a small fraction of his few hundred thousand years of existence he has been but little superior to other animals. The characterization of human history as a 'brief and discreditable episode in the life of one of the meaner planets' is not indefensible." Pp. 421-422.

Professor Baker, on the other hand, exhibits a much truer sense of values and historical perspective. Contrast with the above quotation the following excerpts from his book:

(1) "It is not surprising that the heliocentric theory met with disapproval on almost every hand; for it was a radical departure from the common-sense view of the world that had persisted from the very beginning of reflecting about it. Moreover, it was supported, at the outset, by no convincing proof; indeed, it seemed to be discredited by the evidence of the celestial bodies themselves.

"Tycho Brahe (1546-1601) rejected the Copernican system, because he was unable to observe annual variations in the directions of the stars, which he believed would be noticeable if the earth revolved." Pp. 146-147.

(2) (Although the author mentions Galileo at least eight times in the course of the book, not a word is said about any conflict with Church authorities.)

(3) "In comparison with the enormous scheme of things in the physical universe, man might seem, at first, to have shrunk to insignificance. Early in the account, he apparently disappears as an item of any importance in the scheme; soon the the earth fades from the pictures, along with the rest of the solar system.................. Must we conclude, therefore, that man is of no special consequence in the universe except in his immediate neighborhood?

"It is the special business of astronomy to explore the physical universe, and to describe it as faithfully as possible. Astronomy is concerned with physical values alone. It is competent to say that the great nebula in Andromeda is enormously larger than a man; it is not competent to decide which object is the more important in the fundamental scheme of things.

But to the special question which has been asked there is a definite and satisfactory answer.

"The revelations of astronomy exalt rather than degrade man. They are *his* revelations, based on his own sense experience. Out of the increasingly comprehensive view of the universe, one phenomenon stands forth more conspicuously than all the others, namely, the mind of man." Pp. 503-504.

The quotations from Duncan given above are, to my mind, sufficient to exclude its adoptions as a text book in our schools. The statement about Giordano Bruno is not only dragged in without rhyme or reason, but is erroneous in addition. If every teacher of astronomy were to write to the publishers of the book, stating that because of those assertions an order for so many copies of an astronomy text is being placed with another publisher, we may expect the objectionable passages to be omitted from future editions.

T. D. Barry, S.J.,
Weston College.

Book Review.

An Advanced Course of Instruction in Chemical Principles
By Arthur A. Noyes, Director of the Gates Chemical Laboratory,
California Institute of Technology and
Miles S. Sherill, Associate Professor of Theoretical Chemistry
Massachusettes Institute of Technology.
New York, 1922. 310 pp. Ill. $4.00.

This book which was originally copyrighted in 1917, completely revised and copyrighted again in 1922, and then set up and electrotyped has been reprinted almost every year since then to date. For a book of this calibre, such a record would appear to indicate a real need in the pedagogy of Physical Chemistry strikingly fulfilled. As a text in advanced Physical Chemistry it has been the inspiration and the "bête noir" at times of hundreds of students at M. I. T. and C. I. T., also. And though it taxes the ingenuity of the student and "makes him think", it certainly does teach him Chemical Principles.

The Introduction commences with the following announcements: "In this book are presented the results of the authors' many years' experience with their own classes in the development of a thorough course of instruction in the laws and theories of chemistry from quantitative standpoints. The course is intended for junior, senior, or graduate students of physical chemistry in colleges, scientific schools, and universities, who have completed the usual freshman and sophomore courses in chemistry, physics and mathematics."

"From quantitative standpoints"—that is the key-note of the course as presented. For every principle set forth, beginning with the concept of "Combining-weight", and throughout the rest of the book, the student is presented with "data" from which he deduces the principle, and finds out for himself just how much it works, and just how much it falls short of "the ideal". Thus, the student appreciates the scope of chemical "laws" as proposed and actually comes face to face with their limitations.

To pick out the chapter on the "Gas Laws" for more praise than any other chapter would be like picking out one of the colors of the rainbow and closing one's eyes to the rest. But here, as is the story everywhere in the book, the student actually visualizes, through personal experience with "data", the fact that all the Gas Laws are limiting laws—and, as stated, apply only to gases in their ideal, or unreal state. Thus, he learns the real value of data, which may remain forever, as against the uncertain value of theories, which may change tomorrow.

For most of the students in our schools who have had but an introduction to Physical Chemistry, this book will be quite difficult. But it points out a path which they must learn to follow, who would lead others along the road to higher levels of scientific study. By problems, the student finds himself in any branch of learning. And particularly is this true in the field of Chemistry—and, if we might emphasize, more so in Physical Chemistry.

Joseph J. Sullivan, S.J.
Boston College.

NEWS ITEMS

BOSTON COLLEGE. The department of chemistry is conducting a seminar in the recent developments in the field of chemistry. Meetings are held in the chemistry lecture-hall on Friday afternoon. The first session was held December 5, and the meetings will continue until May 8. The program is dedicated to His Eminence William Cardinal O'Connell on the occasion of his golden jubilee. Faculty of the chemistry department: Rev. J. J. Sullivan, S.J., (Ph. D., Johns Hopkins), Head of Department, Prof. of Physical Chemistry; Dr. David O'Donnell (Ph. D., Ohio State), Prof. of Organic Chemistry and Organic Analysis; Mr. Brendan McSheehy, (M. S., Holy Cross), Prof. of Colloid Chemistry and Kinetics; Mr. Arthur L. Evans, (M. S., Boston College), Prof. of General Chemistry and Inorganic Chemistry; Mr. Harold Fagan (M. S., Boston College), Prof. of Qualitative and Quantitative Analysis. Assistants in the Laboratories: Messrs. J. J. Kelly, E. L. Kelleher, T. J. Shea, T. C. Sheehan, and H. A. Sullivan; graduates of Boston College. — For the coming year, the department is offering four Fellowships in chemistry.

GEORGETOWN UNIVERSITY. Department of Chemistry. The Chemo-Medical Research is established in the new buildings of the Georgetown Medical School. Several rooms have been equipped with supplies and apparatus for this medical research. Dr. M. X. Sullivan of the United States Public Health Service has been engaged to direct the work; he has two assistants. The research work began on February 2nd. The problems at which they are now engaged are: early diagnostic tests for cancer and the study of amino acids with a view to stop degeneration of the kidneys in nephritis. Dr. Sullivan is an authority on the type of compounds under investigation. Father Coyle and his Associates considered these problems so important that they began this work at once, instead of waiting for the construction of the new Chemo-Medical Research Institute. The project is to be financed by two foundations, each over a period of three years.

The Department of Physics. Recently a Gaetner Chronograph has been added to the apparatus of the Georgetown Physics department. It is the tape recording type, with two pins and a tuning-fork of 100 v. p. s. It is to be used to check up on our various timing devices. It consists of a O. I. H. P. synchrenous motor, G. E., of 1800 rev. per min. It has a worm-drive 2 A shaft which rotates once per. sec. Attached to the shaft are eight disks with fibre points attached and these close circuits which may be connected to any instruments for short-time recording. Two of the disks have 30 fibre points, one has 15, one has 10, one has 5, one has 3, one has two, one has 1, thus giving 1 sec, one-third of a sec., one-half., one tenth, one fifteenth, and one thirtieth of a sec., intervals.

A long-wave receiving set was constructed by Brother Ramage for the purposes of recording time signals. It has not been tried out, as suitable coils have not yet been obtained. The single stage of audio amplification feeds into the primary of a push-pull input transformer. The center tap of the secondary is connected to the relay. Two 171A tubes are used, for rectification, plate and grid being connected together. The plate of one tube is connected to each extreme tap of the secondary winding. The center of the filament is found by means of a 50 ohm. shunt center tapped, and this is connected to the other end of the relay winding. A 1 microfarad condenser is shunted across the relay.

In the meanwhile the same service is obtained by using a broadcast receiver. The loud speaker is replaced by the primary of a small rectifying transformer purchased from the American Instrument Company. It is designed to take 110 volts A. C., and to deliver 3 volts D. C., and contains a full wave copper plate rectifier. The D. C., out put of this operates the coil of a telephone relay across which is shunted a 1 microfarad condenser. A double pole double throw switch allows the loud speaker to be thrown in for tuning.

Father Doucette has made photographic reproductions of the Georgetown travel Time Charts, and while there is still some distortion in the latest prints, they will serve for the identification of phases, and the rough determination of epicentral distance, though they will not be as accurate as tables.

The photographic Bosch-Omori was sent to Woodstock during the holidays.

Liquid coupling between pendulum and amplifier seems to be drawing the attention of designers of seismographs. The Galitzin instruments use an electromagnetic link, and yesterday a pamphlet came from Italy describing the Alfari seismograph which uses a purely magnetic coupling, the end of the boom carying a small horse-shoe magnet, while the mirror mounted on a stretched wire, has a small aluminum lever connected to it that holds a small piece of iron in the permanent magnetic field without touching the magnet.

HOLY CROSS COLLEGE. The faculty of the Department of Chemistry for the scholastic year 1930-1931 is as follows:

General Chemistry (Pandemic)............ Professor Strohaver, S.J.
Laboratory Assistants,............................ Mr. Moynihan, S.J.
Mr. Landry, S.J.
Mr. Kleff,
Mr. Delmore,
Mr. McGowan.

General Chemistry (Pandemic),............	Mr. Oelke,
Laboratory Assistants,........................	Mr. VaVerka,
	Mr. Zavarella,
	Mr. Coyle.
Stoichiometry,..	Mr. Oelke.
Inorganic Qualitative Analysis,.............	Assistant Professor Charest.
Inorganic Quantitative Analysis,...........	Assistant Professor Charest.
Organic Chemistry,................................	Professor Langguth, S.J.
Laboratory Assistants,........................	Assistant Professor Baril,
	Mr. Carroll, S.J.
Organic Qualitative Analysis	Assistant Professor Baril,
Laboratory Assistant...........................	Mr. Carroll, S.J.
Organic Ultimate Analysis,....................	Assistant Professor Baril.
Colloid Chemistry,.................................	Associate Professor Kelly.
Physical Chemistry,................................	Professor Haggerty.

GRADUATE DEPARTMENT.

Electrochemistry,.....................................	Professor Haggerty.
Reaction Rates..	Professor Haggerty.
Organic Syntheses,...................................	Associate Professor Kelly.
Metallography,..	Associate Professor Coonan.
Descriptive Metallurgy,............................	Associate Professor Coonan.
Subatomics,...	Professor Haggerty.
Seminar,..	Professor Strohaver & Faculty.

MANILA OBSERVATORY, Manila, P. I. With the installation of a complete set of Galitzin-Wilip seismographs the Manila Obervatory now takes its place among the first class seismic stations of the world.

The Vicentini seismograph which has been in operation since 1912 has been transferred to Baguio and was installed there by Father Repetti in November.

The Vicentini which has been in operation in Baguio has been removed to the Manila Observatory and will be placed among the obsolete instruments. This seismograph was made in the Observatory shops and was exhibited at the St. Louis Exposition in 1904 before being installed in Baguio.

Mr. Leo Welch is engaged in the study of Meterology in the Manila Observatory. He has little opportunity this year of making a first-hand study of typhoons because after the middle of July no typhoon passed close enough to Manila to produce any perceptible effect. It has been a very exceptionable typhoon season.

An earth inductor, manufactured by Gustav Schulze of Potsdam, Germany has just been received at the observatory. This will be used in the magnetic observatory at Antipolo, 28 kilometers east of Manila. The most convenient location must be determined, marble supports erected, and permanent adjustments made. It is hoped to have the instrument ready for routine observations by January 1st 1931. This will supersede the common dip needle and should give more rapid and accurate results.

The variometers in use at Antipolo was purchased in the early '80s and the magnetogram speed is only one centimeter per hour. New and more sensitive variometers would greatly increase the value of the records but factors of expense and more skilfull personnel make their acquisition doubtfully advisable.

CANISIUS COLLEGE. Number of students registered in the science courses: chemistry 332, physics 218, biology 185, astronomy 15, geology 15; total 765 students.

Three graduate students are in course for the Masters' degree in Chemistry. Mr. A. O'Neil Kline, B. S. '28 is engaged on the Thesis "The Relation between the Sizes of Cadogan Coal and the Sulphur and Ash Content." Mr. Walter J. Stahrr, B. S. '24 is preparing "A Comparison of Microscopic Methods for the Determination of Sulphates." Mr. Austin V. Signeur, B. S. '29 is working on "A Microscopic Method for Analysis of Group 3 Metals."—

Father Delaney gave three lectures: January 4, "Einstein's Relativity" illustrated with slides and film, given before the Canisius Alumni Sodality. January 6, "Secrets of Mother Earth Revealed through Seismology" radio broadcast lecture over station WKBW. January 20, "Einstein's Relativity" illustrated lecture given at the Buffalo Museum of Science. Another radio broadcast lecture, to be illustrated by full-page rotogravure in the Courier Express, is scheduled for Feb. 1st, under the title, "The Solution of the Earthquake Problem."

Father Delaney has been elected to membership in the Niagara Frontier Research Council.

LOYOLA COLLEGE, Baltimore, Md. Dr. Neil E. Gordon of the Chemical Education Department of The Johns Hopkins University gave a lecture to the Chemists' Club, his subject: "Chemistry as a Profession." — On January 14, Mr. H. A. Thoman, Secretary of the Baltimore Copper Smelting and Rolling Co., lectured on: "Copper Refining." The lecture was illustrated by motion pictures in colors. — Dr. S. T. Helms of the Emerson Drug Co., gave a practical demonstration of: "Chemistry in Medicine," on February 25. — The department has just installed a Standard Burrell Gas Analysis Apparatus, new series, two purpose senior model B.

Extensive improvements are being made in the department of biology.

WESTON COLLEGE. Rev. F. W. Sohon of Georgetown University gave a series of lectures on the theory and practise of seismology. The seismograph is in operation and daily records and reports are made. — At the semi-annual disputations, Mr. Bernard Baylon read a paper entitled: "The Influence of Underground Waters."

BROOKLYN PREPARATORY. The Brooklyn Prep Science Club is a very active organization and has many interested student-members doing special work supplementary to the regular class assignments. Mr. F. N. Wedder is the guiding Moderator of the Club. Cf. article in this issue of the Bulletin. — Mr. Joseph Foley, A. B., is in charge of the physics department; in the chemistry department are: Mr. William Quinn, A. M., and Mr. Joseph Lavin, A. B. All are graduates of Holy Holy Cross College.

CARROLL UNIVERSITY. The Third Round Table Discussion of Catholic Scientists and Teachers of Science was held at Carroll University, Cleveland, Ohio, December 29, 1930 —during the sessions of the American Association for the Advancement of Science. The members were the guests of the University at luncheon. The Rt. Rev. Joseph Schrembs, D. D., was the guest of honor. About forty members were present: five nuns, one laywoman, eight laymen and twenty-six priests. A report of the meeting will be published. Those interested may communicate with Rev. James B. Macelwane, S.J., St. Louis University.

LOYOLA HIGH SCHOOL, Baltimore, Md. The introduction of chemistry into the high school course this year with a class of fifty-four students brought the total enrollment in the science courses to nearly two hundred. There are eighty students in the biology classes and sixty-six in physics. — Mr. Henry L. Griffin, A. B., Holy Cross, who taught here last year, is again in charge. Holy Cross has another representative, Mr. Edward Matelis who is teaching chemistry. — The physics laboratory had to be removed to new quarters at the beginning of the year when the old physics laboratory was taken over by the chemistry classes.

ROME, Italy. Rev. Father Gianfranceschi, S.J., who accompanied the Nobile Polar Expedition, has been appointed head of the New Vatican City wireless station.

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