A. M. D. G.

BULLETIN

of the

American Association of Jesuit Scientists

(Eastern Section)

For Private Circulation

LOYOLA COLLEGE
BALTIMORE, MARYLAND

VOL. VIII MAY, 1931 NO. 4

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Bulletin of American Association of Jesuit Scientists

EASTERN DIVISION

VOLUME VIII MAY 1931 No. 4

EDITORIAL

Scientific education and research is so vast and intensive at the present time that the number of books and journals published in each branch of science is enormous. Experimental facts, research efforts and results must be recorded in books and periodicals, and this literature is an intrinsic and essential part of work in science. If we are to add to human knowledge we must know exactly how far that knowledge has gone, at least at the point where we are to do the adding. Hardly anything more humiliating can happen to a scientist than to publish a treatise and then to have some one point out that the work had been published in some journal that the scientist should have consulted.

At present practically all the results of scientific investigations appear as articles in the journals, some journals contain nothing else while others have editorials, reports of meetings and other articles. The professor and student should learn to make the best possible use of both. By reading the journals we see science in the making and observe how one fact is added to another. The current journals keep us abreast of scientific thought of the time, of the latest discoveries in the laboratories and of the newest developments in industrial processes. We should cultivate a habit of reading them. It is true that we cannot read *all* of the journals, but we can browse through several and read the articles that appeal to us. It is also advantageous to attend the meetings of recognized scientific societies. Much valuable information is garnered by attending the proper meetings and learning from the masters.

Scientific libraries are the great store-houses of valuable treasures and the immortal truths and thoughts of the world's great. There is scarcely anything more important in the pursuit of a science than a familiarity with and an appreciation of the work of the masters in that science. Departmental libraries in science will stimulate the students, will arouse keener interest in the work of regular classes and develop initiative, self-reliance and leadership. It is one of the essential functions of a scientific course in our colleges to show our students where to find the information they need. Knowing how to find facts in a library is as important as knowing the facts themselves. The time given to lectures is not sufficient to cover *all* the matter assigned, and so the library can supplement the lecture course. Sometimes laboratory work is merely mechanical and a matter of routine. Some students are prone to do too much work with their hands and too little with their heads; a library of well selected books conveniently located with respect to the laboratory will remedy this defect.

The importance of scientific libraries in our system of education cannot be overemphasized and the recognized new books should not be overlooked, nor should we neglect having the journals bound annually. A small thing but an accumulation of small things leads to greatness and perfection.

Science and Philosophy

Dear Father Editor:

Will your readers be patient while a lay mind exhibits some of its bewilderment on the subject of Science and Philosophy. Among other points, on two questions I feel that I can explain why the class of reader not technically trained in Science, but interested in Philosophy, is having some difficulty and seeking some solution.

MODERN SCIENTIFIC TEXT-BOOKS

The authors of these books are men who have rarely read any *systematic course* in philosophy, good or bad. The writers are University men, well-trained in the Sciences; they are not well-grounded in Logic (though they studied it once) and especially are they innocent of Inferior Psychology and Cosmology. Are these facts? It is true that most of the Universities no longer give a systematic training in a solid philosophy; and it is abundantly proved from the text books themselves.

There is a deal of vagueness on the question of the validity and legitimate use of philosophic induction. The untrained mind, I think, is prone to conclude too soon; but the modern scientific mind is inclined never to conclude; there is a distinct tendency to be sceptical until mathematical deductions are possible in the process. Secondly, in speaking of Laws, distinctions are not well enough drawn between the qualitative and quantitative certainty of the Law. Thirdly, where the terminology of Science overlaps with that of Philosophy, oftentimes the exact meaning of the writer is hazy. This is especially true respecting such concepts as substance, accident, property, and especially "charge". Of course, it is easy to suggest the remedy—textbooks written by Ours; and so Logic and Science will go hand in hand. The book of Father Wulf is helpful here, especially his treatment of the Laws of Energy.

MODERN TENDENCIES IN SCIENCES

By the modern period, I mean the renaissance since Roentgen. Up to 1890, our arguments for Matter and Form looked to me more invulnerable than they do now. We have the electron now; and frankly it puzzles me in connection with this problem. Does it, as a unit, or any of its component charges, go through any change of so-called substances, itself unchanged, "sibi identicum", or not? Or is it changeless through all changes? Is electron A or the charge in it, unchanged since the first day of creation? If so we must overhaul our proofs.

Or is it possible that the union and disunion of the opposite charges of the electron furnish the room for a proof *analogous* to our present one from substantial changes? Or are modern views on mass, gravity, velocity, etc., in the electron useable in the argument for Matter and Form from teleological considerations?

It seems to me that something might eventuate if these modern notions, secure and documented by proof of course, were considered from the pure scientific side, and by both the philosopher and the scientist together. It is of course only hopeless scientific conceit which ridicules the *ultimate* solution of the problem which scholasticism has attempted.

Again in this period, the statements of recent relativists need be docketed for us as true or false by our scientists. Some declarations I have seen concerning Hypereuclidean space seem to me distinctly tinged with philosophic Idealism, or at least with an agnostic attitude respecting Realism. Now, are some of these Relativists Idealists? Is there an Idealism, silently expressed though never overtly, in their formulas? The layman's impression is that they have impressed the mathematical world. Is their underlying philosophy right?

Yours sincerely,

W. J. McGARRY, S. J.,
Weston College.

Rev. Eric Wasmann, S. J.

Born: May 29, 1859 at Mirano, South Tyrol.
Early education at Mirano, Hall and Feldkirch.
Entered Society of Jesus at Exaten, Holland; September 28, 1875.

1877-1879 Classical studies at Wynandsrade.
1879-1882 Student of philosophy at Blyenbeck.
1882-1884 Research in Natural History. Assistant Editor.
1885-1889 Theological studies.
1889- Ordained to the Priesthood.
1890-1891 Research at University of Prague.
1891-1892 Tertianship at Vienna. (Lainz)
1892-1899 At Exaten on the Editorial Staff.
1899-1911 At Luxemberg as Author.
1911-1931 At St. Ignatius College, Valkenberg.
Died February 27, 1931.

Father Wasmann published many books, pamphlets, treatises and articles—in all 288 publications; practically all on the results of his research on myrmecophiles and termitophiles arthropods.

REV. ERIC WASMANN, S. J.

Entomologist

"Vade ad formicam, o piger
Et considera vias ejus,
Et disce sapientiam."

Prov. VI.—6.

On Friday, February 27, at ten o'clock in the evening, the world-renowned Jesuit, Father Eric Wasmann, passed to his eternal reward at the age of seventy-one, at St. Ignatius College, Valkenburg, Holland.

For almost a year, the aged scientist suffered from a heart ailment which in its incipient state did not noticeably hinder him in his manifold scientific activities; but since last November, this fatal disease confined him to his bed and occasioned the most serious misgivings. Consequently death did not unexpectedly steal upon the renowned scientist, even if the notice of his demise came as a sudden surprise and shock to the greater number of his many friends and admirers.

Eric Wasmann was born on May 29, 1859 in Mirano, a city most attractively situated in the Tyrolese Alps. For his early education, his father, Frederick Wasmann, a German from Hamburg, a convert and artistic painter, placed him in the "Stella Matutina", a boarding school in Feldkirch, Austria. Soon after his entry into this institution, at the age of sixteen, he entered the Society of Jesus in 1875. During his student years in the Society, he became a member of the editorial staff of the periodical "Stimmen aus Maria Laach", now known as "Stimmen der Zeit". In this capacity he found a work and labor most suited to his nature and talents.

He chose as his special branch of research the life and habits of ants, termites and their related genera. The book: "Kritisches Verzeichnis der myrmekophilen und termitophilen Arthropoden" published by Dames, Berlin, in 1894, laid the foundation for a new scientific branch of zoology and thereby occasioned notable progress in this science.

Father Wasmann published no less than 288 treatises in this field. Well known are his works dealing with the psychology of ants in particular and animals in general; such as "Das Seelenleben der Ameisen", and "Die psychischen Fähigkeiten der Ameisen und der höheren Tiere."

In 1899, he went from Exaten, Limberg, to Luxemburg, where the tireless author gave to the world it's first Catholic exposition of General Biology in his work published by Herder in Freiburg: "Die Moderne Biologie and die Entwicklungstheorie." His lectures dealing with the problem of evolution, given at Berlin in 1907, created a great sensation for they aroused even the apparent indifference of Ernst Haeckel. Since 1911 Father Wasmann lived at St. Ignatius College in Valkenburg, and here he devoted himself not only to scientific lectures, but also to the continuance of his specialty and to the assembling of a great and incomparable scientific collection.

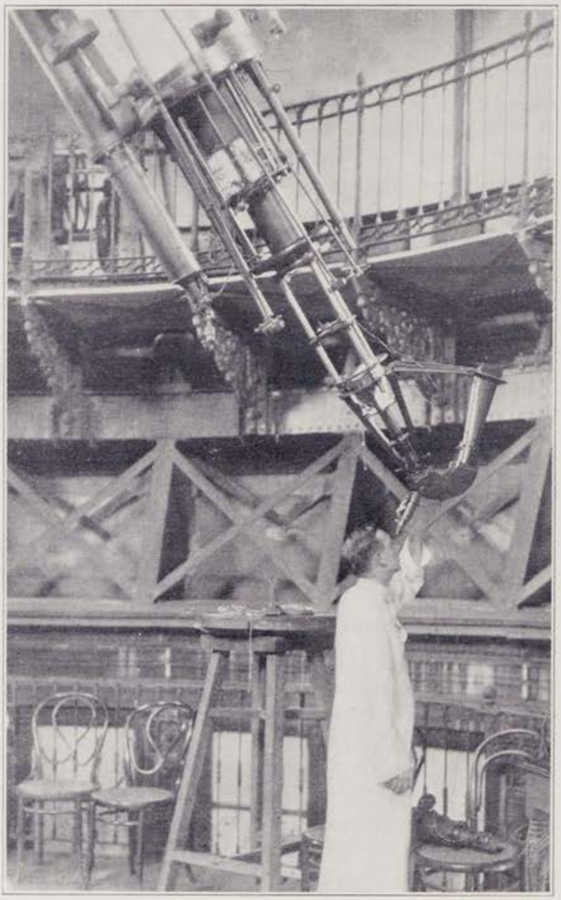
In the course of these years, many distinctions and honors of the scientific world were conferred upon him. His greatest joy was the publication of the book, dedicated to his seventieth birthday. This was edited and published by Dr. W. Horn, and in it famous scientists of the entire world, friend and foe alike, as the preface of the books states, gave their comment of praise to the now aged yet ever active research worker. In the death of Father Wasmann, the world has lost a catholic naturalists to whom it owes considerable gratitude for progress in more than one field of endeavor. He was a man of exemplary diligence, endowed with rare literary ability, and blest with undaunted courage in upholding the truth. His collections will be preserved under the title of "Wasmann's Museum", by a member of the Society and will be used to continue the research work he so nobly started.

PARTIAL LIST OF PUBLICATIONS OF REV. ERIC WASMANN, S. J.

B. Herder Book Co., St. Louis, Mo.

The Trichterwickler or Leaf-Roller. 1884.
Atemeles and Lomechusa. 1888.
Comparative Studies of Ant-Guests. 1889.
Composite Nests and Mixed Colonies of Ants. 1891.
Critical List of Myrmecophile and Termitophile Arthropods. 1894.
A Treatise on the More Recent Theory of Evolution in Germany. 1896.
Instinct and Intelligence in the Animal Kingdom. 1897. 3rd Edit. 1905; Engl. 2nd Edit. 1903; Russian 1906; Ital. 1908.
Comparative Studies of the Soul-life of Ants and of the Higher Animals. 1897. 2nd Edit. 1900; Engl. 1905; Russian 1906.
The Psychic Faculties of Ants. 1899. 2nd Edit. 1909.
New Doryline Guests. 1900.
Termites of Ceylon. 1902.
More Exact Information of the True Guest-relationship of Ants. 1903.
Doryline Guests of the Congo. 1904.
Modern Biology and the Theory of Evolution. 1904. 3rd Edit. 1906; Ital. 1906; Engl. 1910; Polish 1913.
The Soul of Man and of Animals. 1904. 7th Edit. 1922.
Origin of Slavery among Ants. 1905. 2nd Edit. 1910.
Ants and Ant-Guests of Luxemburg. 1906. 2nd Edit. 1909.
The Conflict in the Problem of Evolution. 1907. Danish 1908; Engl. 1909.
Biological Instruction in Colleges and Universities. 1908.
The Theory of Evolution and Monism. 1910.
Ants and Their Guests. 1910.
A Contribution to our Knowledge of Termitophiles. 1912.
How the Theory of Evolution is Abused. 1913.
New Contributions to the Biology of Lomechusa and Atemeles. 1915.
Social Life of the Ants. 1915.
New Accommodation Types among Doryline Guests. 1917.
Haeckel's Monism a Menace to Culture. 1919.
Christian Monism. 1919. 2nd Edit. 1920.
Care of Guests among Ants. 1920.
Ant Mimicry. 1925.
Man and Organic Nature (with Sebastian Killerman). 1925.

(We are indebted to Rev. Henry Wolff, S.J., for obtaining the facts of Father Wassman's life and labors.)



Astronomical Building
Manila Observatory, Philippine Islands

Rev. C. E. Deppermann, S. J.,
at the telescope

ASTRONOMY

THE ASTRONOMICAL DIVISION OF THE MANILA OBSERVATORY

REV. C. E. DEPPERMANN, S. J.

A little resume' of the routine activities of the Astronomical Division of the Observatory may be of interest to the readers of the Bulletin.

We may divide the work into three parts: a) the time service, b) observations of variable stars, c) work on atmospheric electricity.

a) With regard to the time service, the correct time must be obtained, it must be preserved, it must be given out. Every two or three days, weather permitting, the sidereal time is determined by means of the Repsold Broken Transit. Though the instrument is not of the latest type, and though the disturbed atmosphere often makes the stars "dance a jig", still it is surprising how for a single night the values of the time obtained from different stars agree among themselves. The average deviation is usually only one or two hundreths of a second from the mean. This is due in good measure to the elimination of the collimation error by reversing the instrument for each individual star, together with level reading for the same. The "tap key" method is used, since the impersonal micrometer provided with the instrument does not permit of very smooth movement. My personal equation is small, so that it is safe to use the older method. In fact, the deviation from the mean is one half that obtained when the impersonal micrometer is used. When the weather is poor for a good stretch, e. g. during the rainy season, recourse must sometimes be had to radio to get the time signals from Bordeaux, Nauen and Rugby. Annapolis is not often heard. Besides, the best signals, those of Bordeaux and Rugby, can only be heard at the hours of two and four o'clock in the morning. Three radio sets are at our disposal, one a long wave "barrage" set, a gift from the Navy, a medium wave set, and a Superwasp short wave set. The last mentioned is also used to get the weather reports every morning from Father Gherzi, at Zi-ka-wei (Shanghai).

By the above means we check the rates of our master clocks, of which there are three, one sidereal and one mean time Riefler, and one mean time synchronome. When the weather is steady, all three clocks, especially the synchronome, keep excellent time. Strange to say, although all are kept under constant pressure and temperature, the rates are subject to sudden, unexpected and often simultaneous changes. A tilt of the pier (we are only a few feet above the water line) is suspected. Due to these unexpected changes, a sharp check on our clocks by frequent star transits is a necessity, especially since we have been made a "first order" time station, i. e. one whose signals are usually correct to less than one tenth of a second, and which may be used for scientific purposes.

Twice a day, time signals for five minutes controlled by the Observatory are sent out by Radio from NPO, Cavite Navy Radio Station, and by a short wave transmitter of the Manila Railroad. Cavite emits both on long and short wave. This year the Observatory expects to install at least a five hundred watt short wave transmitter for gathering in and transmitting weather reports, and in all probability our time signals will be sent out also on it. Once a day time is sent out through the telegraph lines of the Islands. The Cavite signals are received on our radio and automatically recorded on the chronograph, together with the seconds from one of our master clocks. Thus the correction to our wireless signals is accurately known. Every two months the list of corrections is sent to the different Observatories of the Far East. These signals are used by ships, by surveyors, and by other Observatories, e. g., Kwasan Observatory, Japan, by eclipse expeditions, etc.

b) With regard to the 19" Merz equatorial, a problem has at last been found which promises steady work during the clear season. The "poor seeing" so prevalent here prohibits accurate work with the excellent micrometer of the Observatory; photometry too needs a much better sky. Our spectrographs would need very extensive alterations to make them up-to-date, and even then success would be problematical. At the suggestion of Father Hagen, of venerated memory, visual observations of long period variables was tried. As the comparison stars in this method are all in the same field of view as the variable, there was some chance of success. Many test observations on variable stars in Father Hagen's Atlas Stellarum Variabilium were made last year, and the results sent to Harvard for comparison with their own plots. The answer was so encouraging, that work on long period variables has been decided upon as part of our regular program. In the good season, it is expected that about 150 observations each month can be made, two observations a month for each variable selected. This is as much as can be expected of the astronomer, who has in addition his other labors during the day to attend to.

c) Up to the present, the atmospheric electricity work has been mainly confined to getting the variations in potential gradient. The results of the first year's work are summarised in one of the publications of the Observatory. For the further study of some of the interesting problems that arose, an appropriation of One Thousand Dollars was obtained this past year from the Government. With this sum we are purchasing new equipment, especially adapted for the study of the ions in the atmosphere, upon whose amount it is now thought that the characterists of the daily potential gradient curve largely depend. Due to timely suggestions from the Bureau of Terrestrial Magnetism in Washington, the appropriation has been put to very good advantage by purchasing the instruments very cheaply in Germany and Austria. When these instruments arrive, the Observatory should be splendidly equipped for pursuing interesting research work in Atmospheric Electricity.

NOTES

According to a notice in a recent "Astronomishe Nachrichten", Father S. Chevalier, S. J., died during October, 1930, at the astronomical observatory at Zo-Se, near Shanghai, China. He held the position of Honorary Director of the observatory, and was 79 years old when he died. He did much good work in the study of star clusters. I quote the following from a recent work, "Star Clusters", by Harlow Shapley, director of Harvard College Observatory. "Kustner and Chevalier, among others, have made accurate modern catalogues of positions in several galactic clusters. As a basis for future analyses of proper motions, this work is of high importance, since reliable measures of motions may soon be forthcoming for those galactic clusters that are relatively bright and near." (p. 103). "Messier 46; an important photographic catalogue by Chevalier." (p. 234).

Our Scripture scholars may be interested in articles published recently in "Astronomishe Nachrichten" on the date of the Crucifixion. They appeared in Vol. 240, numbers 9-10 and 22. They may be found in the principal public libraries.

THOMAS D. BARRY, S. J.

BIOLOGY

SCHOLASTIC APTITUDE TEST FOR MEDICAL SCHOOLS

REV. C. E. SHAFFREY, S. J.

Since we are all more or less occupied in training men who are to study medicine an exchange of ideas on the scholastic aptitude test ought to find a place in the bulletin. Some may not have had an opportunity to see the examination and so a few words as to its nature and the purpose of its several parts seem to be necessary.

Under No. 4 of the directions to the examiner conducting the test we find the following:—"After all the students are seated, the following statement should be read before any papers are passed out. The test which you will take is designed to give indication of your ability to undertake the study of medicine. It is being given in all premedical schools in the United States at this hour. The test measures your ability to understand and organize the same kind of material that you will have in the medical school, and it indicates how well you have learned in the past. You will each receive a preliminary study sheet, on one side of which you will find an anatomical diagram together with a discussion of the same. You should study this page for ten minutes. On the back of the preliminary sheet you will find two passages to study. You will have 15 minutes on the back page. If you finish studying the back page before time is called, you may turn the sheet over and review the diagram. Later you will have a number of questions asked about these passages and the diagram."

After the twenty-five minutes of study on the preliminary sheet these were collected and then the test proper was given out, and one hour was allowed for answering the questions of the six different tests.

The first test was a list of fifty pairs of words to be marked S (same) or O (opposite) showing a man's scientific vocabulary.

The second test was for visual memory. Here the same anatomical diagram was shown as was seen on the preliminary sheet, this time the names of the structures being listed and numbered, the student being instructed to place the proper number opposite the line indicating the structure in the diagram.

The third was a memory test and consisted of twenty statements to be marked T. (true) or F (false). These pertained to the description of the organs and other structures included in the diagram given on the preliminary sheet.

The fourth test was made up of a list of ninety statements to be marked true or false. These were concerning the matter of physics, chemistry and biology.

The fifth was a test of a man's power of comprehension and retention and consisted of forty statements to be marked true or false. These covered the matter of the second passage on the preliminary sheet which treated of the anatomy of the eye, accommodation and errors of refraction together with short paragraphs on several diseases, infectious, systemic, nervous or blood diseases.

The sixth measured a man's ability to understand printed material of a scientific nature. It required careful reading and thinking to answer the ten questions which followed. The several paragraphs dealt with the "oxygen debt" and "recovery" connected with physical exercise. These questions were well adapted to test a man's power to think and were probably the hardest met with in the examination.

While many of the so-called psychological tests and aptitude tests are rank nonsense and in no way adapted to indicating the ability or fitness tested, I feel that this test is certainly calculated to bring out a man's aptitude and preparedness for the study of medicine. In my opinion it was in no way unfair or unreasonable. The time given was short, but in all probability that was intended to be a part of the examination. While the test is intended for the convenience and safety of the medical schools in selecting their Freshmen, we who have prepared the men have a keen interest too, and I stated this fact in my letter to F. A. Moss, in an effort to make clear, that while they are seeking to check up their estimate of the applicants by comparing it with the degree of success attained by the student in his Freshman and Sophomore years, they could be helped in evaluating the efficiency of their test by letting us know their judgment of our men, and hearing from us how their ideas of them square with our knowledge of them after having taught them for several years. Up to the present I have received no word in regard to my request that they let us know their rating of our men who wrote the examination. Possibly some attention might be paid to such a request from the colleges if more of the men who conducted the test would send in the same request.

GLOCHIDIAL ATTACHMENT

Rev. F. J. Dore, S. J.

The reproduction of the Mollusca has several interesting features. The ova, when discharged, are held between the two lamellae of the outer lamina of the gills, and there fertilized by the spermatozoa, which have been sucked in through the incurrent siphons. The fertilized eggs develop into the characteristic larvae, or glochidia as they are called, which are set free by the mother whenever a fish swims into the neighborhood.

The glochidia seize the nearest part of the passing fish, generally the tail fin or a gill. While they are developing there for some weeks, the skin grows over them, and they are thus afforded protection and also nutriment by their host. Their sensitiveness to the nearness of a fish is very remarkable, but it is evidently essential to their continued existence; for if they fail to attach themselves in this way, they sink to the bottom of the water, and perish. These facts are, of course, well known; but it is unusual that one may observe the actual phenomenon. This occurred however, in one of our aquaria lately.

A pregnant female of the Xiphophorus Helleri variety had been placed in a brood tank, and at the same time one of the Anadonta was put in as a scavenger. After a few days the young Helleri were discharged, and soon afterwards a laboratory assistant called my attention to the fact that a small yellow substance was appearing on the baby fishes whenever they reached the vicinity of the mussel. It seemed hardly likely that we were witnessing a glochidia attachment, but microscopic examination and the camera proved that it was actually taking place. Within twenty-four hours, skin was found to have grown nearly over the parasite on the small fishes which survived. On the mother Helleri, the growth of skin entirely covered them within a week.

Some months ago, the Science Magazine reported that the professor of physiology at the University of Missouri, Dr. Max Ellis, would carry on a winter's research in mussel raising for the U. S. Bureau of Fisheries. He claims to have found a nutrient medium which takes the place of the fish as a host, and which medium contains all the substances which the growing glochidium finds necessary for its normal development. This Spring, fishery officials hope to plant in the Mississippi valley sixty million mussels, raised on this new diet. If successful, this ought to lower the price of pearl buttons considerably.

PROTOZOOLOGY LABORATORY AT FORDHAM

Rev. Joseph Assmuth, S. J.

A new laboratory was opened at Fordham, for the purpose of studying Protozoa. Several all-glass aquaria are arranged facing the light in such a manner that the animals can be seen without disturbing the aquaria. The problem of raising some of the Protozoa is still a problem of research, and many interesting points along this work are in progress here. We have now on hand pure cultures of Paramoecium caudatum, Euglena gracilis, Stentor, Didinium nasutum, Paramoecium aurelium, Spirostomum mambiguum, Stylonychia mytilus, and Amoeba proteus. Many of the methods now employed are fallaceous because they only keep the specimens for a very short time. We have worked out several methods that keep the specimens permanently.

In two aquaria we have Hydra fusca and viridis, also several larvae of aquatic insects.

These new aquaria have aroused great interest in the students, and small sections are sent to the laboratory to observe the specimens.

We intend to study the Protozoan fauna of the nearby ponds.

Experimental work is being carried out by Dr. James A. Mullen and Dr. Mark T. Crowley under the direction of Dr. George Roemmert of Muenchen, Germany.

WHEN SCIENCE SPEAKS

Lloyd F. Smith, S. J.

Not so long ago Julian S. Huxley, grandson of Darwin's famous champion, gave a course of lectures at the Academy of Music, Philadelphia, Pa. While none of the lectures in question were noteworthy for brilliance either of thought or presentation, an analysis of any of them is interesting as a typical illustration of the workings of some contemporary minds, though to one exasperated by the thought of "How do they get away with it?" it will probably afford no solution to his difficulty.

The third lecture included most of what had been given in the two previous, and so we may confine our attention to that. The outworn trick, traditional to popularizers of Science, was used constantly. I refer to his use of the phrase "Now science tells us . . . " whenever he felt that some one in the audience might think that he was overstepping the limits of actual fact. Fortunately, however, none of his audience were doing any more serious thinking than he was. You could tell that by the knowing way that every one nodded approvingly whenever he made some statement especially inane. It was a pleasant evening without serious brain fag for any one present.

Huxley got under sail by informing us he would talk on "Biology and Human Thought" but upon an attack of modesty he modified it to "The Effects of Science on Theology", graciously refraining to name the denomination whose theology was in question. The marvelous evolution of thought (of which his own, supposedly, was a delightful example) was contrasted to the static outlook of the dark, dark, past, especially during the Middle Ages (of which, he implied, we must speak in pity as we would of a weak-minded ancestor).

To attain the proper perspective Huxley first reviewed the findings of Astronomy, pointing out the movements of our solar system, its insignificant part in its own island universe, while at distances reckoned in millions of light years were countless other island universes. But most appalling of all, it appears that the intense heat of these bodies renders the existence of matter there possible only in the simplest electronic forms, when electron and proton dash aimlessly about at indecent speeds. Accordingly it seems that the harmony of the celestial spheres has been recognized of late by the acute ears of science to be merely cosmic jazz, even without reason for its very existence, (not to mention its discord). For this reason the highest point achieved by astronomical thought is Agnosticism.

Taken into Physics and Chemistry and there introduced to the Natural Laws we found on examination that they proved to be iron-clad, not enjoying the freedom of human laws where novelty is sometimes introduced by a prudent magistrate making an exception. Hence any phenomenon above the natural order is impossible, and as for miracles or a Being capable of working them, they belong to the delusions of fairyland. The only logical conclusion from Physics and Chemistry is absolute, irrevocable Naturalism, which denies as heresy anything superior to physico-chemical laws. We may now modify our former Agnosticism sufficiently to certainly exclude the supernatural.

With the foundations now securely laid the lecturer proceeded to his chosen field—Biology. Since all is ruled by the laws of Physics and Chemistry, life itself must be dependent on them and vital phenomena are but manifestations of these same laws. Any argument about Spontaneous Generation is, therefore, absurd since life is but another aspect of the inorganic world. As for the varied types of living things we all are aware that they arose by evolution, conscious organisms slowly evolving from the non-conscious, the more complex from the simpler until we arrive at the obvious intelligence of the dog and monkey, passing by easy stages to the highest evolution of consciousness that is found in man. Now this is quite natural since, as we have shown, mind and matter are but different aspects of one and the same substance. To be explicit they are both ultimately reducible to the common denominator—electricity.

At this point Huxley paused from his strict argumentation and almost threatened to become poetic in admiration of the sublimity of the concept that the matter of our limitless universe should have progressed so simply to the power of reflection. But marvelous as may be its intricate working the value of the mind is questionable, for our cognition can never be more than imperfect and relative. We should be consoled, at least, by the great advance made already by Natural Selection and Chance Variation as they guide us on (to our meaningless, inexplicable destiny).

The noblest field of all knowledge, Huxley declared, is Phychology and here he outdid his former efforts. Realizing once more that mind and matter are apparently inseparable we must conclude that they are one and the same thing. Now matter is essentially the same wherever found, and since we are but chance aggregations of matter the old belief in a personal, individual existence is untenable. As parts of one material whole it is absurd to think that we are apart from our fellows. Consciousness is to be explained, naturally enough, by the interactions of these fortuitous bundles of matter, the subconscious and the unconscious minds being but the repression of our naughty consciousness.

From the foregoing there are several conclusions to be made for our guidance. First of all hold fast the truth that ours is a world of change, of evolution, of progression. Then it follows that no truth is absolute, exception probably being made for the one sure fact that there is nothing supernatural, God being ruled out of the world long since by the discoveries of science. Thus Newton's laws of gravitation dispensed with the need of a world Mover, as certianly as Darwin's theory of natural selection, by disproving any possibility of design in living things, rendered obsolete the tradition of a world Designer.

All this, the lecturer admitted, might be a trifle puzzling, a similar line of thought probably explaining the present chaos in modern times (and on this point we certainly agreed.) Today when men are wondering as never before whether life be worth the living, suggesting universal suicide as the most likely remedy for the world's ills, we must turn for guidance to our inner consciousness, the only norm of action. That will inform us, he hoped, that we should enlist at once under the standard of Scientific Humanism, which will make possible and inspire a new life within us.

Finally we must whole-heartedly embrace Agnosticism, since we cannot know how the present evolution of the cosmos came about, nor do we faintly guess whither it is destined to progress in the future. Still we can do our part to direct the forces of evolution by right ways to its unknown destination. Be that as it may, all matter is linked in bonds of continuity, a consolation to us all. (That last sentence puzzled me a bit). The fade-out came with Julian leading us on to the promised newer life, exalted by the realization that man is (these are his exact words) "The crown of the biological kingdom, a most curious phenomenon of world stuff, a trick in the playing forces of cosmic evolution."

I admired the simplicity of the young lady whom I overheard remarking to her companion as we left the Academy of Music,—"Really I don't know what he was talking about all the time." She probably reflected the thoughts of all present. Why? Eddington may have had a prophetic vision of that evening's lecture when he wrote: "When we encounter unexpected obstacles in finding out something which we wish to know, there are two possible courses to take. It may be that the right course is to treat the obstacle as a spur to further efforts; but there is a second possibility—that we have been trying to find out something which does not exist." Then there may be another explanation. For we had just heard that "Now Science tells us" that personality is an impossibility and how can a non-existent individual be expected to appreciate fully the marvels of scientific truth, even when Science speaks?

PHYSIOLOGY AND PSYCHOLOGY

REV. C. E. SHAFFREY, S.J.

Knowing that the teachers of Philosophy are finding a need for some knowledge of the anatomy and physiology of the nervous system on the part of the students of psychology, I felt it might be of interest to the readers of the bulletin to know what type of a course we give in neurology here at St. Joseph's College. We cover the matter included in Herrick's Introduction to Neurology and Ranson's Anatomy of the Nervous System. Our course consists of two lectures and two laboratory periods a week for one quarter.

After a short review of the development of the nervous system, the characteristics of the neuron, and the General Physiology of the nervous system, we make up the various types of reflexes, the study of receptors and effectors of various kinds, and then study the structure, and components of the spinal nerve. Then the external configuration and the interal structure of the spinal cord, mapping out the afferent and efferent tracts and noting the types of impulses they conduct, and the termination of these various tracts in the brain. Then in turn the medulla, pons, midbrain, cerebellum, basal ganglia and the cerebrum are studied in the same manner. The cranial nerves are then taken up as to their origin, constituent fibres, terminations and the types of impulses they carry. When this much has been completed the senses are studied and the olfactory, visual, auditory, tactile, thermal, and gustatory impulses are traced from the receptor to their cortical termination. Finally the sympathetic or visceral nervous system is taken up in a general way.

The laboratory work consists in the microscopic study of the neurons and the fibres of every portion of the system, the location of the various nuclei in stained sections of the various parts, together with the study of the human brain for the external features and the origin of the cranial nerves, and then on sections of the human brain locating the main masses of gray and white matter, tracing as far as possible the path of fibre tracts from the cortex to the brain stem and spinal cord, and the reverse.

A sheep's brain well hardened is first studied in detail and dissected so that the student has a fairly clear idea of the relations of different parts before attempting the study of the human brain.

The appended examination will give an idea of how much is expected of the student, and the accompanying grades may indicate their degree of sucess in coming up to our expectations.

This course is offered as a senior course to the B. S. students but would be an impossible course to men who had not had the previous training in biology which the B. S. men get. As a part of a general course to A. B. students it could be condensed, but the very matter which would be most valuable to students of psychology could not possibly be grasped without a detailed study of the anatomy and physiology of the nervous system.

The matter to be included in a general course such as the teachers of psychology would suggest for all students will be an interesting subject for discussion at our convention this coming summer.

FINAL EXAMINATION IN NEUROLOGY

1. Trace an olfactory impulse from its origin to its termination by all possible paths.
2. Trace impulses representing the left field of vision to their terminations.
3. Locate the nuclei of the following:—oculo-motor nerve, trochlear nerve, abducens nerve, hypoglossal nerve.
4. Locate the cortical area for speech, hearing, touch, pain.
5. Bound the lobes of the cerebrum.
6. Locate the fóllowing:—emergence of the 5th cranial nerve, the pineal body, habenular nucleus, mammillary body, posterior perforated space.
7. State the possible paths for an impulse from the hair cells of the organ of Corti to the cerebral cortex.
8. Trace an impulse from the precentral gyrus to a spinal nerve by all possible routes.
9. What and where is the internal capsule? Why so called?
10. What impulses travel in the following:—ventral spino-thalamic tract, lateral spino-thalamic tract, fasciculus cuneatus?
11. State the location of the cells of origin of the preganglionic and post ganglionic fibres of the sympathetic system.
12. Where do the fibres of the medial lemniscus take their origin? Where do they terminate?
13. Give the location of the function of the nucleus ruber.
14. Name and locate four tracts in the lateral funiculus of the spinal cord.
15. Locate and state the constituent fibres of the gray ramus.
16. Give the paths of gustatory impulses to the brain.

Results:— 99, 96, 89, 88, 84, 83, 60, 60, 56, 42, 24.

N. B. Answer any ten questions.

A CORRECTION

Errata in the Article on Sex-determination in the March issue:

The last sentence on page 17 should read: "At present it seems very probably that the three theories of environmental agencies, different metabolic levels and internal cell mechanism will be reconciled and combined to give us something very near the truth.''

Line 38 on page 19 should read: 'third type, called WZ-ZZ . . . ' etc. (not WX-ZZ).

CHEMISTRY

QUANTITATIVE GAS ANALYSIS

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

The purpose of quantitative analysis in undergraduate courses is to acquaint the students with the *various methods* employed in this phase of analytical chemistry. The ordinary procedure is to give lectures and laboratory work in typical methods of gravimetric, volumetric and electrolytic analysis, to which is added the practise of calculations in quantitative work.

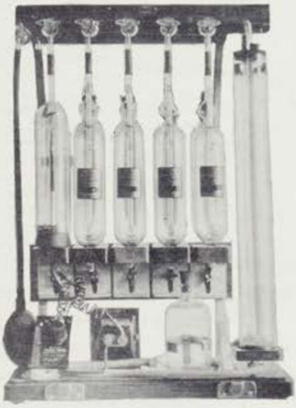


Fig. 1

In this standard course there are no methods of quantitative absorption, a procedure which is of importance in industrial laboratories. Typical examples of this kind of analytical work are had in steel analysis and gas analysis. (An article on steel analysis appeared in this Bulletin, Vol. VI—Proceedings.)

Our students majoring in chemistry should have a working knowledge of gas analysis, since so many industries demand a check on gas products in order to prevent waste, to get greater efficiency and to increase the number of by-products. Just to mention a few of the gases that are analyzed daily in industrial laboratories: blast-furnace gas, coke-oven gas, producer gas, natural gas, flue gas, sewer gas, mine air, water gas, exhaust gas, compressed fuel gas, compressed oxygen, hydrogen, nitrogen, etc., etc. The need of accuracy is evident; an error of .1 or .2% in the determination of some of the components of a gas may form a large item in the profit or loss of a plant producing 250,000,000 cubic feet of gas per day and selling it on B. t. u. basis. Analysis is based on observed volume changes made upon a fixed portion of the gas, an error in the determination of one component is usually thrown upon another, and in some cases such an error may indicate the presence of a component really absent. Even in control work accuracy is of extreme importance.

The laboratories of the United States Bureau of Mines and the United States Steel Corporation have perfected a gas analysis apparatus that is of the highest efficiency. The new and improved designs include refinements, both mechanical and electrical, which add greatly to the accuracy, speed, convenience and safety of gas analysis. There are two general types: laboratory models for permanent installation and portable models for the sake of convenience. The permanent models use mercury as the confining liquid in the calibrated burette and the portable models use water.

Figure 1 is a portable senior model B, made according to the specifications of the United States Bureau of Mines by the Burrell Technical Supply Co., Pittsburgh, Pa. It has all the appliances that are necessary for accurate results. With this model the following gases can be analyzed quantitatively: carbon dioxide, illuminants, oxygen, carbon monoxide, hydrogen, methane, ethane and nitrogen. The procedure of analysis is thus: a measured portion of gas sample is subjected to successive treatments to remove the various components, measuring the change in volume of the sample after each treatment to determine the quantity of the particular component present. Some of the compounds are readily absorbed by liquid reagents contained in absorption pipettes. The gas is passed from the burette into the pipette repeatedly until absence of further contraction in the volume of the sample indicates that the particular component has been entirely absorbed. Some components cannot be absorbed, and these are burned in a slow combustion pipette or in a copper oxide tube.

The various components of industrial gases are determined in this way: carbon dioxide is absorbed in a solution of potassium hydroxide in an absorption pipette; oxygen in a solution of alkaline pyrogallol; illuminants, which include unsaturated hydrocarbons such as ethylene, propylene, acetylene, which cannot be separated by ordinary combustions and absorptions are absorbed as a group by fuming sulphuric acid; carbon monoxide is determined by absorption in a solution of cuprous chloride and concentrated hydrochloric acid; hydrogen is passed into the copper oxide tube or slow combustion pipette, where the hydrogen is oxidized to water and the contraction in volume of the sample gives the hydrogen content; nitrogen and other inert gases of the air are determined by difference.

We installed a two purpose, portable senior model B gas apparatus in our laboratory this year. We included this experiment in our course of quantitative analysis with excellent results.

MATHEMATICS

ROTATION AND PERVERSION GROUPS IN EUCLIDEAN SPACE OF FOUR DIMENSIONS

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

A study of symmetry in space of four demensions. Symmetry is defined as a group of orthogonal transformations. Rotations in space of four dimensions are factored into components having the properties of quaternions, so that the investigation falls back on the known properties of rotations in space of three dimensions. The synthesis of rotations from quaternions is complicated by the "blending" of the quaternions, which is explained in detail. Perversion proves to be still more complicated than rotation, but the distinction between types and species makes possible the formulation of general principles so that a systematic classification of symmetry is finally obtained. In the last two parts the pyramids with polyhedral bases and the polyhedroids are discussed, and their places in the systematic classification were found. These parts were added because the quaternion investigation is algebraic rather than geometric, and is hard to visualize.

In relation to the work of Weyl, the methods are in a broad sense the same, the transformations are similar in character, both make the big step of decomposing the transformations into simpler ones. The work of Weyl in connection with Lorentz transformations is so similar that the equations might easily be mistaken for one another by the hasty reader, but there is no actual duplication of results. Weyl deals with continuous groups instead of finite groups.

As the 4-space rotation is important in connection with the Dirac electron, the author was invited to explain the blending of quaternions and the subsequent building up of the various finite groups to an audience of mathematicians from M. I. T. and Harvard who were interested in investigations along similar lines.

Editor's Note: The original article: "Rotation and Perversion Groups in Euclidean Space of Four Dimensions" by Father Sohon appeared in the Journal of Mathematics and Physics, Vol. IX—No. 3, 1930; sixty-six pages. Father Sohon delivered a lecture on the subject of his paper to the members of the mathematics department at the Massachusetts Institute of Technology. Anyone wishing a reprint of this article may communicate with the author at Georgetown University, Washington, D. C.

THE HIGH SCHOOL MATHEMATICS SITUATION

JAMES D. LOEFFLER, S. J.

The agitation at our recent conventions concerning the mathematical preparation, or rather the lack of it, of our students entering college, is not entirely groundless. On the other hand there is something to be said in opposition to a change, on the ground that mathematics in our high schools is taught as an end in itself, for the development of the faculties of the mind which can be trained only, or chiefly, through this medium; and *not* as an adjunct to a science course, or to facilitate the work of physics and chemistry teachers.

The two ends are not in any way conflicting, and a pupil well versed in the science of pure mathematics will be well equipped for taking up the sciences of the college curriculum, although he may be unfamiliar with the applications of his mathematics to the practical problems of a particular science.

THE DIFFICULTY is in obtaining and retaining this equipment in the limited time which may be given to mathematics in a full high-school course. The time allotted is quite sufficient for the *teaching* of the subject, thoroughly and entirely, I believe. But this does not mean that the average pupil will grasp the matter and retain it. When a new principle has been taught, much time must elapse, and many examples and exercises in the application of it must be done before it can be said that the pupil has mastered the point. Since new advances and new points must be made almost daily, this means constant daily exercises and practice outside of school hours to obtain the desired results. Lacking this, the time must be taken from teaching periods for doing examples and problem work. For many types of students the impossibility of giving sufficient concentration to the work under these circumstances to understand what they are doing, causes them to follow a formula or model blindly. In addition the teacher is unable to cover all the matter properly, if so much time must be taken out for exercises in the classroom, and something must be left "unstressed", which means not learned.

This difficulty has been met by the expedient of memory study of rules and formulae, from the application of which problems can be solved by the pupil, theoretically. In reality, the end of mathematics, as a developer of the reasoning powers, is, to a large extent, sacrificed, and the pupil is handicapped later on by a confused recollection of these many rules, the logic back of which was never fully grasped.

The failure in mathematics in college is a failure of brute memory, applied where it was never intended that it should be. The defeat is not of one, but of both, purposes of the mathematics course. The very nature of mathematics (unused outside the classroom and occupying a niche apart in the minds of most boys of high school age) as well as its high purpose of developing very immature and slow-working intellects into clear, keen instruments of thought, demands more time and more freedom from distracting external circumstances than is requisite for *any other high school subject;* that *ideas* and *principles* may be assimilated, and impressed on the intellectual memory. Once grasped thus, they can never be forgotten in the manner of mere words and definitions.

A second difficulty, which is really nothing more than an aggravation of the first, consists in the frequent gaps in the development of mathematical reasoning during the course from the beginning of high school through college, especially in the solution of equations and practical problems where independent thinking is required. These occur in the third year of high school, again in the second term of fourth year where but one term of trigonometry is required, and in first year college. It is evident that a deeper grasp of principles is required than that which can be retained by memory, if the student is to be able to tackle with confidence the problems of physics, or take up advanced work in calculus.

The gaps, of course, may be minimized to a large extent. Geometry offers many opportunities for the application of algebra to problems, if teachers could be encouraged thus to renew the acquaintance of the boys with fractions, decimals, radicals, surds, logarithms, and other schoolboy bugbears. A year's course in trigonometry, interspersed with algebra reviews and applications, as occasion offers, as v. g. progressions, graphs of functions, imaginary numbers, natural logarithms, etc., will cover the necessary ground to a large extent, and prevent the decay of the mathematical ground work through disuse.

Again, the difficulty is not in *teaching* the amount of matter prescribed, but in being able to require a large amount of practice in the exercise of principles already taught, but of which a comprehensive understanding can come only through those hours of personal effort and concentration outside of the classroom. In our inability to demand this, it seems to me, lies our present difficulty.

PHYSICS

RADIO AMPLIFIER PATENTED

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

A private demonstration of a new scientific principle for the amplification of radiant energy with no regeneration, as patented by Rev. Joseph J. Daley, S. J., was given at Boston College on Thursday, April 9th, 1931. The basic patent was filed in 1927 and granted in June 1930. Well known physicists and radio engineers witnessed the demonstration. Mayor Curley, Reverend Father Provincial, the Presidents of Boston College, Weston College and Boston College High School, members of the Physics Departments of various colleges and radio engineers from most of the large corporations were present.

Rev. John A. Tobin, Head of the Physics Department of Boston College, explained the meaning of non-regenerative amplification and its advantages; then he introduced the inventor Father Daley. After Father Daley explained his patent, Mr. Walter M. Cusick, President of the Research Products Corporation gave a practical demonstration and comparison of the regenerative sets and the new six stage of radio frequency amplification in the new Daley circuit. The tone, power, selectivity of the non-regenerative set built according to the Daley patent, the new type of high μ tube and the new system of power control were clearly demonstrated. A luncheon was served to the invited guests, and the radio engineers had a chance to inspect the sets and make the comparisons themselves.

Address of Rev. John A. Tobin on Non-Regenerative Amplification.

The problem today in radio is analagous to the traffic problem in our large cities. In order to solve this traffic problem we have traffic lights. But even with traffic lights, there is still difficulty. So for the *maximum* transfer of traffic we have *one way* streets. If we watch traffic on a one way street, we see the surge when the light is green and the pause when the light is red. But we note that all the street is used and we have the maximum transfer of traffic in the same direction.

If you look at a radio tube you find three elements or electrodes. The hot filament, either of itself or by the heating of a device called the cathode, supplies the electrons. These electrons flow to the plate. In between is the grid, and this grid represents the traffic light. When the grid is negative you have a red light and the electron flow is hindered, and when the grid is positive you have the green light and the flow is increased. This grid is controlled by the radiant energy sent by the broadcasting station. But this incoming energy is very weak and must be amplified by the tubes. If we amplify this energy at its radio frequency before it is impressed on the detector tube, we gain in selectivity and also reduce background noises.

However, this amplification in the radio frequency has been limited, because the tubes caused undesired oscillations, and this feedback or regeneration caused disturbances that made this method limited. According to Professor Morecroft the tube is not a one way street but a repeater and two way street. To remedy this defect in a regenerative circuit various devices have been made to block the flow of these disturbing currents. But if we block off the left hand side of the street, so that there is no traffic there, we are interfering with the maximum transfer of traffic, because we are not using the full street. In the same way all the neutralizing and suppressing devices to block these undesirable currents prevent at the same time the maximum transfer of energy.

Father Daley by his patented circuit makes the tube a one way street. In his circuit there is no suppressing of the feedback and thus losing the maximum transfer, because by his circuit there is no feedback or regeneration. By its nature this circuit is a non-regenerative circuit. This is done by making the interelectrode capacity such that there is a zero difference of potential between the grid and plate. There is no flow when the two elements are at the same potential and so there is no regeneration. Yet the electron flow from filament to plate is not hindered and so the tube becomes a one way street.

The advantages of this maximum transfer of energy is clear. Now greater power is possible and this without distortion from the feedback. What this means to radio will be clear from the demonstration. What it means for the future in television where the eye detects the smallest distortion is also clear. The outstanding superiority of this non-regenerative amplification as regards tone, power, selectivity will be understood by hearing the comparison of this circuit with the regenerative circuits.

BENDING OF BEAMS

JOSEPH T. O'CALLAHAN, S.J.

A study of the bending of beams makes a popular and interesting experiment and is commonly performed in our Physics Laboratories. But the derivation of the equation for bending used in this experiment is not found in the ordinary text book or laboratory manual; and the derivation found in texts on Applied Mechanics is too long and involved for ready reference.

There is need then, of a short, but rigid proof of the formula for deflection of beams, supported at both ends and loaded in the middle;

$$D = \frac{Wl^3}{4Ea^3b}$$

D=total vertical sag

W=load

l=length of the beam

E=Young's Modulus

a=depth of beam

b=breadth of beam

In the derivation the order shall be: considering a cantilever beam, to get an expression for the Radius of curvature in terms of E and the bending moment; from this to get an equation for for $\Delta\theta$, the angle between tangent lines at two points on the elastic curve, using this to get the differential equation of sag. Then apply these results to a beam supported at the ends and loaded in the middle.

When a beam is bent, the convex portion is evidently stretched and in a state of tension, while the concave portion is compressed. Somewhere between there is a neutral layer which retains its normal length; the curve assumed by the neutral layer is called the elastic curve. The curvature is the reciprocal of the radius of the circle that would fit this curve at the point in question. The line which the neutral layer makes with any cross section is called the neutral axis.

It is true that non-uniformly bent beams, which we are discussing, suffer a shearing stress as well as a longitudinal stress. An experimental demonstration of shear in beams is outlined by Jameson in "Elementary Practical Mechancis", page 256. Proof that the shearing stress may be neglected without making our conclusions too inaccurate is given by Poynting and Thomson, "Properties of Matter", page 89. Prescinding then from the slight shear, the only stresses are longitudinal, and Young's Modulus is the only elastic constant which will enter our equations.

To get an expression for the Radius of Curvature (R) of the elastic curve in terms of Young's Modulus (E) and the Bending Moment (B. M.).

Consider a portion of the beam x inches long extending from the left end A to any point P. $\overline{PP'}$ is the neutral axis at P.

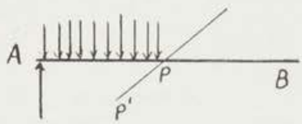
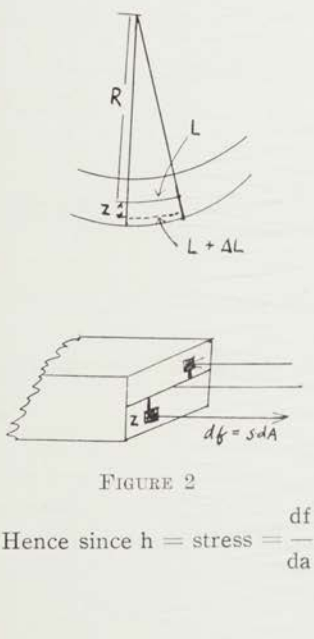


FIGURE 1

The B. M. is the algebraic sum of the torques about the neutral axis at P, of all external forces applied to that portion of the beam to the left of P. For equilibrium this B. M. must be balanced by the total torque about the neutral axis of all the internal forces, compression and tension, exerted upon the portion $\overline{AP}$, by the portion $\overline{PB}$ of the beam to the right of P.

To determine these internal forces: Let h = stress, which varies with the distance z above or below the neutral axis. Since we are dealing only with Young's Modulus, $h = \frac{E.\,\Delta L}{L}$ (1) where L is the natural length of the element. Also, if R is the radius of curvature of the elastic curve.



$$\frac{L + \Delta L}{L} = \frac{R + z}{R} \quad (2)$$

$$\therefore \frac{\Delta L}{L} = \frac{z}{R} \quad (3)$$

Combining (1) and (3)

$$h = \frac{Ez}{R} \quad (4)$$

FIGURE 2

Hence since h = stress $= \frac{df}{da}$; df the element of force acting on the element of area dA is: $df = h dA = \frac{E}{R} z dA$ (5)

And its moment about the neutral axis PP' is zdf.

$$\therefore \quad z df = \frac{E}{R} z^2 dA = \frac{E}{R} z^2 dy.\, dz \quad (6)$$

The total internal moment which for equilibrium must balance the B.M. is

$$M = \frac{E}{R} \int\int z^2\, dy\, dz \quad (7)$$

Now $\int\int z^2 d\, dz$ is the Moment of Inertia of Area about the neutral axis PP': for this we shall use the symbol I and evaluate it later

$$\therefore M = \frac{EI}{R} \ ; \ \therefore R = \frac{EI}{B M.} \quad (8)$$

To determine $\Delta\theta$, the angle between the tangent lines of two points on the elastic curve.

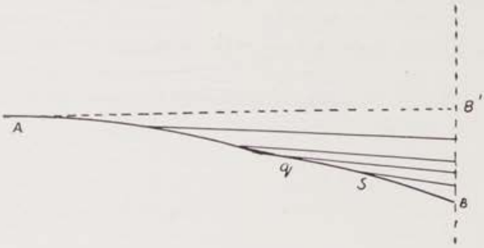


FIGURE 3

Let Figure 3 represent the curved position of the neutral layer. Suppose Q and S are two points near together on the neutral layer. The angle between the tangents at Q and S $= \frac{\overline{QS}}{R} = \Delta\theta$ where R is the radius of curavture of $\overline{QS}$: (for the angle between tangents equals the angle between radii to the point of tangency.)

$$\therefore \Delta\theta = \frac{\overline{QS}}{R} \quad (9)$$

$$\text{But } R = \frac{EI}{B.M.} \quad (8)$$

Here the B.M. at Q = weight (W) times the distance $\overline{BQ}$; ∴ M = W· $\overline{BQ}$;

$$\therefore \Delta\theta = \frac{W}{EI} \overline{BQ}.\overline{QS} \quad (10)$$

or if s = $\overline{BQ}$;

$$\Delta\theta = \frac{W.{}^{s}ds}{EI} \quad (11)$$

To get the equation of sag

If the end of the beam is clamped so that its tangent is horizontal, then the distance $\overline{BB'}$ will be the total vertical depression of B produced by the W. We wish to determine $\overline{BB'}$.

Let the tangents at Q and S cut the vertical line through B at M and N. Then since the sag is not great, and the tangents are not far from horizcntal we have approximately $\overline{MN}$ AQ.Δθ (12) (approximately)

If D is the total sag dD $\overline{MN}$ by substituting (11) and again with BQ s:

$$dD = \frac{W.\ s^2\ ds}{EI} \quad (13)$$

and the total sag is

$$D = \int_0^{ab} \frac{Ws^2\ ds}{EI} = \frac{W\overline{AB}^3}{{}^3EI} \quad (14)$$

This is the equation of sag for a cantilever beam.

Equation for beam supported at both ends.

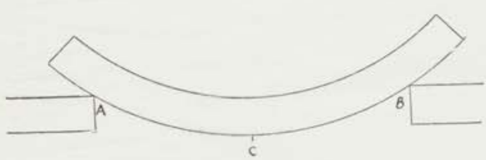


FIGURE 4

Finally to determine the equation for a beam supported at both ends and loaded in the middle, we need only show that equation (14) holds with proper changes for this type also.

The tangent at C, the mid point is evidently, horizontal and the presure on each support is $\frac{W}{2}$. Considering the portion AC of the rod, it has the tangent at C horizontal, and is acted upon by vertical force $\frac{W}{2}$ at A. Hence the conditions are the same as for the cantilever beam just discussed. Therefore the vertical distance between A and C is given by equation (14)

$$\therefore D = \frac{W}{2EI} \frac{\overline{AC}^3}{3} \qquad (15)$$

$\overline{AC} = \frac{1}{2}$ where I = length of beam. (16)

To evaluate I, the moment of Inertia of Area rectangle about the neutral axis PP'

$$I = \iint Z^2 \, dy \, dz$$

$$\frac{I}{4} = \int_0^{\frac{a}{2}} \int_0^{\frac{b}{2}} Z^2 \, dy \, dz = \frac{a^3 b}{48}$$

$$\therefore I = \frac{a^3 b}{12} \qquad (17)$$

substituting (16) and (17) in (15) we get

$$D = \frac{WI^3}{4Ea^3b}$$

Note: There is a detailed study of the subject in "Applied Mechanics", Vol. 2, Fuller and Johnson. "Elementary Practical Mechanics", Jameson, describes various experiments with beams, but does not derive the formula. "Properties of Matter", Poynting and Thomson has an excellent chapter on "Bending of Rods". "Mathematical Analysis, Higher Course", Griffin, has several scattered paragraphs on the subject. The last two texts were used freely in preparing this article.

A MAGAZINE FOR THE PHYSICIST

JOHN G. TYNAN, S. J.

We have been familiar since its inception with a little magazine, whose acquaintance we feel, would profit our Science-teachers, especially the Physicists. The magazine is called 'Instruments' and claims to be 'a monthly publication devoted to the instrument problems of all industries'. Its primary purpose is to furnish in a single periodical, descriptions and information on instruments used in all the industries; to present new and effective developments in instruments, and to give them to its readers in a thoroughly comprehensive manner. It is of interest to the Physics teacher, because it serves to acquaint him with the means employed in the industries to ascertain the measurements, with whose laboratory determination he is regularly employed.

A list of some of the major articles in the first three volumes may serve to illustrate its claim to the attention of the Physicist. They are:

Developments in laboratory apparatus in 1929.

Electrical Refrigerator measurements.

How Hair Springs are made.

Testing the hardness of metals.

Measuring to four parts in a billion.

X-Rays in Industry.

Instruments for the solution of triangles and polygons.

Design of instrument transformers.

The care of electrical instruments.

The measurement of pulsating currents.

In addition to these major articles several new instruments or improvements are described and pictured in each issue. In this section of the magazine, during the past few months the following instruments were introduced: A new volt-ohmmeter, small wire gage, analyzer for sound picture installations, new resistance unit, new potentiometer pyrometer, running-sheet micrometer, three position pilot switch, etc.

At the present time the main article section is taken up with installments of three books, one of which is a translation from the German. This latter is entitled "Measurements, Industrial and Scientific" by Dr. Walter Block, equivalently Director of the Bureau of Standards for East Prussia. The amount published to date gives evidence that this will be a complete and thorough treatment of the science of measurements and will prove a valuable reference work for the teacher of Mechanics. Beginning with the issue of January 1931, a new serial, much closer to the Physics teacher's problems is presented. It is entitled "Handbook of Laboratory Instruments and Apparatus" and the first installment deals with balances, analytical and torsion, their characteristics, their use and their care. It is written in clear and simple language and abounds in illustrations and diagrams. The "Handbook of Industrial Instruments", the third book that is appearing serially is closely allied to the above and while it has been slightly more technical than the former promises to be, it also has an appeal for the Physics teacher, in that it shows practical application of Physics principles and Physics instruments.

A feature of the magazine is a Catalogue library, in which it lists the descriptive literature issued by Instrument manufacturers. Copies of all the literature listed are supplied by the publisher and information concerning any instrument or instrument problem can be had from the Editor.

If this sketchy review of the contents of 'Instruments' has aroused your interest, a card to the publishers will, I am sure bring you a sample copy, from which you can conclude whether or no it will be worth your while to subscribe. The address is Instruments Publishing Company, 3619 Forbes St., Pittsburgh, Pa. The subscription price is Two Dollars.

A CALENDAR OF PHYSICS EXPERIMENTS. (Cont.)

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

2. HEAT

17. THERMOMETRY. First Effect of Heat—Change in Temperature.

a) Exhibition of various types of thermometers.
1) Standard Gas. 2) Liquid in glass, as mercury and alcohol. 3) Metallic. 4) Maximum and minimum, clinical and recording thermograph.

b) Large chart with Fahrenheit and Centigrade scales.

c) High temperature recorders as thermocouples, resistance thermometers and optical pyrometers.

18. CALORIMETRY. Measurement of Heat Quantity.

a) Exhibition of calorimeter and method of mixtures.

b) Demonstration of determination of Specific Heat.

c) Bomb calorimeter.

19. EXPANSION. Second Effect of Heat—Change in size.

a) Coefficient of Expansion. Heat rod and it turns gears that move a large pointer. Heat ball and place in ring.

b) Unequal expansion. Heat compound bar and it bends. Heat glass tube and plunge in water and it cracks. Large model of thermostat. Compensating pendulum.

c) Bulb for expansion of liquids. Maximum density of water apparatus.

d) Boyle's Law apparatus and air thermometer for expansion of gases. Long tube of air immersed in water. Heat air and it bubbles through water.

20. FUSION AND EVAPORATION. Third Effect of Heat—Change of state.

a) Demonstration of determination of latent heat of fusion.

b) Regelation with ice and wires and weights.

c) Melt glass rod in burner for fusion of non crystalline substances.

d) Freezing of mercury in dry ice.

e) Expansion of water in the ice bomb.

f) Evaporation of liquids. Two Torricelli tubes and ether to show vapor pressure.

g) Demonstration of determination of Latent Heat of Evaporation.

h) Boiling point of water. Boil water in Pyrex boiler. Boil water in flask and invert flask. Cool flask and pour cold water on it. Boil water at room temperature in the vacuum pump.

i) Triple point. Watch crystal, water, dryer in vacuum pump.

j) Iron plate for spheroidal state.

k) Sublimination of camphor and dry ice.

l) Determination of humidity by wet and dry bulb.

m) Determination of dew point by blowing ether through highly polished metal container.

n) Distillation with tube of alcohol and aniline.

21. TRANSFER OF HEAT.

a) Conduction in solids. Rod with fan of different metals. Objects drop off at different times as paraffine melts. Wood and brass rod. Paper is charred over the wood. Davy miners lamp. Trevellians rocker on lead block.

b) Conduction in liquids is poor. Use test tube with water and ice.

c) Convection of liquids. Heat water in paper basket. Miniature hot water heating system with water colored with aniline.

d) Convection of gases shown with chimney and candle and T shaped partition. Charts of ventilation systems.

e) Radiation. Melt a piece of solder in focal point of concave mirror. Use thermopile and wall galvanometer to show radiations from candle. Also heater coil that does not glow for invisible radiations. Used polished and blackened surfaces before the thermopile. The radiometer. Thermos bottle.

22. THERMODYNAMICS.

a) Exhibition of apparatus for determination of the mechanical equivalent of heat.

b) Model steam engine. Large model of cylinder and valves.

c) Moving pictures from Stone and Webster to show turbine.

d) Model of four stroke gasoline engine.

e) Exhibition of pony brake.

f) Moving pictures from General Electric to show process of refrigeration. Icy ball unit made by the Crosely Radio Co.

(Electricity to follow)

SEISMOLOGY

THE SEISMOGRAPH

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

What is a seismograph? It is a nicely balanced pendulum, as delicate as a watch, that apparently gives a response out of all proportion to the cause that excites it. What wonder it excites in the visitors that come to see it! What wonderful questions it compels these people to ask! One must admit that our complicated instruments with their high magnification are really wonderful toys to be exhibited on occasions to amuse our friends and arouse their admiration. Or again it may appear in the light of a clever piece of demonstration apparatus exemplifying the laws of the pendulum, the mechanical advantage of levers, the behaviour of solid and liquid friction, and in some of the more recent types geometrical optics electricity and magnetism are not neglected, so that if we include the radio set that is necessary for the time signals, practically a whole course in physics can be explained in the instrument room. In this light the seismograph rises somewhat in importance, but it is still a toy.

If the seismograph is put to work, if it is kept in adjustment and its records are taken and examined it becomes a news agency. It will tell us at times that an earthquake has taken place, give us the distance about once in five times, and much more rarely the direction of the disturbed region. If this is all we ask of the instrument, then the records once read need not be kept. The record should be inspected at times during the day, or if the record is not open to inspection, a photo-electric cell can be fixed up to give the warning when a disturbance of a certain magnitude has been recorded. As a news agency the seismograph has some value, at least a value as a source of advertizing to the college. Perhaps this reason even justifies the cost of their up-keep, even though it hardly recompenses the observer for his care in keeping the instrument in adjustment. Viewed as a news agency the seismograph is a nuisance to the seismologist. He becomes the prey of newspaper men, an encyclopaedia for the curious and a target for cranks. His routine is broken, records are removed from the instrument prematurely, computations are made hurriedly, clock corrections are extrapolated and a large amount of conjecture must often be resorted to. The time of maximum and the end of visible motion as reported to the papers have no conceivable scientific value, but they are asked for, while the arrivals of specific trains of waves, if reported, are either disregarded or made into separate earthquakes. Viewed as a news agency, the seismograph is more than a toy, but not a scientific instrument.

If the message which the seismograph delivers is studied with greater care, details may be revealed concerning the earthquake which could not have been obtained otherwise. There is, of course, the accident of an earthquake occurring in a sparsely populated or unpopulated area, or in the sea. The depth below the surface can sometimes be computed, the direction of motion at the epicenter reveals itself as the direction of motion of the principal part of the S(hake) phase, seismic zones can be mapped, and the accelerations that engineering structures have to withstand in earthquake regions will have to be determined by instrumental records. Thus the seismograph brings information about the earthquake that makes our instruments outrank the telegraph. It brings an autographed account written by the principal cause. Our seismograph grows more important but its principal scientific value does not lie here, nor even its principal commercial application.

The importance of the earthquake is historical rather than scientific, but the occurrence is itself an important scientific occasion. For the original message is distorted in transmission, it is a palimpsest with messages from the rocks through which it is transmitted.

It is not the original autograph that is of so much interest but the superposed message that tells the story of its passage through the interior of the earth. The vibrations from the seismic focus penetrate deep into the earth. They strike the core and bounce up or go through and are refracted. Reflections take place from various surfaces, there is dispersion, certain wave lengths are favored, elastic properties of material deep below are revealed by velocity of transmission, shadow zones and focal points tell other stories, to say nothing of Love or transverse surface waves which cannot exist in an isotropic elastic medium, but must be sustained by total reflection in a subterranian surface of continuity. All this is written into the record for the scientist to read. But if the seismograph is to be a scientific instrument, its records must be kept and the records must be loaned to investigators for study. But before embarking on the study of a given earthquake, a seismologist wants to know a number of things about the earthquake which can only be obtained from preliminary readings of the various records, so that preliminary bulletins of readings become a necessary part of the routine of international cooperation.

Finally the seismograph has become a commercial instrument. In the discussion at the A. I. M. E. in 1928 Mr. DeGolyer says:

The seismic method practically replaced the torsion balance . . . I believe our people, when asked how much ground they can cover in a search for salt domes, usually say 100,000 acres a month . . . In the

Gulf Coast Area the geological work will not give the information, so that puts it out of the question. There is only one other method that does give the information and that is by drilling wells, which would be tremendously expensive, because in order to prove the ground either positively or negatively it would probably be necessary to drill a pattern of wells about 1½ miles apart. From the standpoint of the shooting reconnaissance, we believe we can do it for 11 to 15c per acre, according to how the land lies, and the ease of communication, accessibility and all that sort of thing. It varies with the method of working and the object sought. In the Gulf Coast region, I believe they are trying to make their shots about five miles long, and of course it makes a great difference how many receiving stations are used.

So we see the seismograph to some is a toy, to others a mere exemplification of applied physics, to others a news agency, to others a careful observer of earthquake phenomena, to others it relates the physical structure of the interior of the earth helping the prospector to discover orebodies and salt domes, helping the philosopher to construct a plausible cosmogony.

BOOKS

GALILEO, COMETS AND OTHER THINGS

THOMAS D. BARRY, S.J.

The hydra of mythology was a queer beast. Whenever Hercules cut off one of its many heads, two more heads grew to fill the vacancy. The hydra has its modern counterparts in the numerous lies which have been told about the opposition of the Catholic Church to science. It seems that whenever one of these lies is traced to its source and killed, it springs up again in two or three other places. Henry Smith Williams, B. Sc., M. D., LL. D., has written a book entitled "The Great Astronomers (Simon and Shuster), which is a veritable encyclopaedia of these many attacks which have been launched against the Church. Good rationalist that he is he does not confine himself entirely to the Catholic Church. Luther, Calvin, Zwingli come in for their share of abuse for their over-insistence on following literally the words of Sacred Scripture, yet they play only a minor part in the story. It was the Catholic Church that threw the wrench into the wheels of scientific progress and carefully nursed the superstition and ignorance rampant in Europe until the time when men were strong enough to break away from her sinister influence. A typical example of the offensive manner in which Dr. Williams treats this subject is the following passage, which comprises Book II of the volume:

THE CHRISTIAN WORLD—TWELVE CENTURIES OF PROGRESS

(325—1543, A. D.)

> From the Council of Nicaea, at which the Emperor Constantine made Europe safe for Athanasian Theocracy, to the time of Copernicus, whose great work, teaching that the earth is not the centre of the universe, was to remain under ban of the Council of the Inquisition until fifteen centuries after the Nicene victory, the record of astronomical progress in all Christendom may most charitably be expressed in these words: [followed by three and a half blank pages]. (Pp. 99-102)

Dr. Williams might just as well blame the Church because Columbus did not send daily radio messages back to Spain reporting his progress across the unknown seas. Up to the time of Galileo, astronomical knowledge comprised about everything that could be learned with the unaided vision. Further progress was made only with the use of the telescope. Because this was invented only after the revolt from Rome, Dr. Williams practically makes a "post hoc, ergo propter hoc" argument out of it. Perhaps he would like to explain how it was that great progress in anatomy was made by the papal physicians even at the time of the Reformation (see "The Popes and Science" by Dr. James J. Walsh), or that serious experimentation in electricity was not carried on until two centuries after the Reformation, and then by two Catholics, Volta and Galvani.

His adherence to the principles of Rationalism is shown frequently throughout the book by references to passages in the Bible as the work of the "Oriental poet", "Oriental dreamer", or the like. On the title pages of four out of the eight books into which the volume is divided, passages are quoted from the Scriptures, but they are assigned to the "Oriental Anthology": (for instances, Genesis I, 7, 8, 16, 17 at the beginning of Book I, and Apocalypse XXI, 1 at the beginning of Book VIII). He forgot himself in one or two places, however, as a passage on page 401 is attributed to "Isaiah LI, 6". Perhaps Dr. Williams admits that that prophecy is the inspired Word of God. If so, he should admit the rest.

From "A Note About the Author" at the end of the volume, we learn that Dr. Williams, after practising medicine in New York for several years, went to Europe, where he spent about ten years, devoted to intensive research in hospitals, museums, universities and libraries, with incidental study of art in Munich and Italy.

> The results of these studies appeared in the form of three vast works: "The Historians' History of the World", "The Art of Writing", and "A History of Science", aggregating 40 volumes, and in various minor works; and in numerous articles in magazines, contributions to the Encyclopaedia Brittanica, and other learned works. [One might be led to wonder how much depth of scholarship can be represented in such a staggering amount of writing on such diversified subjects.] Amid all these varied interests, Dr. Williams has found ample leisure to pursue consistently a boyhood enthusiasm for Astronomy which began when, as an eight-year-old, he noticed the discrepancy between the two accounts of creation in Genesis." (P. 619)

A precocious youth, indeed. He himself introduces the subject in the body of the work:

> In France . . . the Court Physician Jean Astruc set the world agog by discovering, after years of learned investigation (what any unhampered boy of eight can discover for himself in five minutes)

that two accounts, mutually contradictory, of the origin of the cosmos are found in the first two chapters of the Oriental anthology which was the basis of all the opposition to the acceptance of the Copernican system. (Pp. 235-236)

The two accounts referred to are given in Genesis, I, 1-31 and II, 4-25. The difficulty lies in this, that the narrative of the second chapter of Genesis **apparently** places the creation of the members of the vegetable and animal kingdoms after that of man, whereas in the first chapter man's entrance into the world comes as the last and crowning feature of creation. It should not take five minutes for an intelligent adult (any unhampered boy of eight to the contrary notwithstanding) to satisfy himself that the two accounts in question are not contradictory, but rather supplementary. The first chapter gives a general summary of the whole work of creation. In the second chapter, however, is begun the story which is the principal subject of the Bible, namely the story of man in his relations with his Creator. Consequently the first narrative, in Chapter I, is repeated in more detail and with emphasis on the beginning of man. As far as the order of events is concerned, in II, 8 we read: "And the Lord God **had** planted a paradise . . . ", the past tense of the auxiliary indicating that the creation of trees, etc., antedated the advent of man. Nowhere is it said that the creation of trees or animals is subsequent to that of man.

Giordano Bruno, of course, is brought into the picture for his periodic canonization. An entire chapter (Chapter VIII. Bruno the Protagonist, pp. 122 ff.) is devoted to him. Dr. Williams does inject a slight bit of truth into the narrative, when he states that "the young iconoclast", after entering the Dominican order at the age of fifteen, thirteen years later

> hurriedly left Italy to avoid the consequences of his avowed disbelief in the doctrines of transubstantiation and of the immaculate conception. (P. 123)

I said "slight bit of truth", since the dogma of the Immaculate Conception was not defined until 1854, and Bruno could not have been brought to task at the time for not believing it. Be that as it may, Dr. Williams very conveniently forgets the theological errors, and tells of the wanderings of his martyr through Europe and his having to leave Switzerland, Paris, England and Germany because he taught the Copernican system. Bruno is finally brought back to Italy, where he falls into the clutches of the Inquisition, by whom he is put to death at the stake. Dr. Williams very naively forgets to mention the charges brought against Bruno by the Inquisition, leaving his readers to infer that his death was due solely to his advocacy of the heliocentric theory. (On page 271, he does state explicitly that "Bruno was burned at the stake for teaching that our earth is not the center of the universe, and the plurality of worlds.") As a matter of fact, Bruno's adherence to the Copernican system had nothing to do with his condemnation. Among the many heresies with which he was charged were his statement that Christ was only a very skilful magician, that the devil will be saved, and that the Holy Ghost is the soul of the world. Incidentally it might be mentioned that he was not burned alive, but was strangled before his body was consigned to the flames. The calumny about Bruno has been refuted at length many times: by Father Cortie in "the Month" for July, 1889, and by Father John Gerard in the same magazine, June, 1908. A short discussion of the question, brought up again by Sir James Jeans in his latest work, "The Mysterious Universe", is contained in "The Month" for January, 1931.

Dr. Williams' particular bete noire is naturally the Galileo case. This is the one stock example always brought forward as proof of the opposition between the Church and Science. It is rather a proof to the contrary. If the adversaries of the Church could prove any other example of the supposed "warfare", be assured that Galileo would not occupy the spotlight alone. But, in the words of Professor Whitehead of Harvard:

> In a generation which saw the Thirty Year's War and remembered Alva in the Netherlands, the worst that happened to men of science was that Galileo suffered an honorable detention and a mild reproof, before dying peacefully in his bed.

We cannot entirely exculpate the Holy Office for its condemnation of Galileo. It made an erroneous decision on a subject on which it was not competent to judge. It was led into error by the prevalent overinsistence on the authority of Aristotle, on a too literal interpretation of the Scriptures, and on the appearances of the heavens themselves. A sane view of the subject is taken by Professor Robert H. Baker, of the University of Illinois, in a recent volume:

> 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 reflections 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. ("Astronomy: An Introduction." Pp. 146-147)

It was not realized at the time that the Bible had been given to man to show "how to go to heaven, not how the heavens go". However, Galileo, a very tactless and provocative person, must bear his share of the blame. At his first trial, in 1616, his opinions were called scientifically false and heretical, as being opposed to Holy Scripture (though his works were not put on the Index until a later date), and Galileo himself promised not to teach them as facts. If he had adhered to his promise and not openly defied the Inquisition by publishing further work on the subject, it is probably that he would have escaped further molestation from the Holy Office. As it was, his disobedience resulted in his being hailed again before the Holy Office in 1632, and condemned to imprisonment at the pleasure of the tribunal. The execution of this sentence would undoubtedly find great favor with the modern sentimentalists. He was permitted to use the comfortable houses of his friends as the place of his confinement. The statement made by Dr. Williams, that he was buried in unconsecrated ground, is false. On his deathbed, he received a special blessing from Pope Urban VIII, and his body was laid to rest in the Church of Santa Croce, Florence, which was surely consecrated ground.

The opposition of the Church to Galileo's teaching seems to be especially obnoxious to Dr. Williams, as though it were the only time in history that a scientist had to fight for his convictions. Dr. Williams himself notes instances to the contrary. Speaking of Newton's discovery of the composition of white light, he says:

> It is hardly necessary to add that, notwithstanding the conclusive character of Newton's work, his explanations did not for a long time meet with general acceptance. (P. 183)

Again, after describing the discovery of the law of gravitation:

> Did the new theory, then, find immediate acceptance? Far from it. This was not the age of miracles. (P. 189)

Other instances of similar nature may be found in the book, as, for example, on page 447, where he mentions that Russell's speculations on the life history of a star were not universally received. The reason for the opposition to new theories is given on page 376:

> The average man of science is in this regard not far different from the average layman. Perhaps unconsciously, but none the less consistently, he is impelled, when confronted with new discoveries that he cannot at once bring into relation with current ideas, to abandon, not the current ideas, but the new discoveries. That is why it takes two or three generations for a really revolutionary idea, however well fortified, to make its way in the scientific world.

The same is true in all sciences. Robert H. Murray, an English Protestant minister, in his work, "Science and Scientists in the Nineteenth Century", shows that the way of the great scientific discoverers of that period was far from being a path of roses. Jenner and Simpson, Lyell and Lister, Pasteur, Joule and Helmholtz were all bitterly attacked because of their new theories. "Let us be logical," says Dr. Williams (p. 165). Yes, indeed, let us be logical. Why take it for granted that there should be opposition to the discoveries of Newton and others, not from ecclesiastical authorities, but from their fellow scientists, and yet cover the Church with opprobrium because it did not immediately admit the heliocentric theory, which, as Dr. Williams himself admits "had not been **demonstrated** by Copernicus or Galileo" (p. 221), and which was not demonstrated until 182 years after the theory was propounded?

The old, old fairy story of "The Pope and the Comet" next comes in for its share of attention. After quoting Andrew White, whose book, "The History of the Warfare of Science with Theology in Christendom", has been ably taken care of by Dr. Walsh in "The Popes and Science", Dr. Williams proceeds to tell us:

> The Pope of that period, Calixtus III, is said to have been so alarmed at the appearance of the celestial monster [the great comet of 1456] as to have "decreed several days of prayer for the averting of the wrath of God, that whatever calamity impended might be turned from the Christians and against the Turks".
>
> "And that all might join daily in this petition, there was then established that midday Angelus which has ever since called good Catholics to prayer aganist the powers of evil. Then, too, was incorporated into a litany the plea, 'From the Turk and the comet, good Lord, deliver us' ". (Pp. 209-210)

Dr. Williams seems to have forgotten all about the Bull of Excommunication which Calixtus is reputed to have fulminated against the innocuous comet. The whole myth has been exploded time and again (among other places, "America", vol. I, p. 689 and II, pp. 139 and 567). But as Dr. Williams has probably never seen a copy of "America", I shall refer him to "Popular Astronomy", October, 1907, where Rev. William F. Rigge quotes the exact words of Platina (the Vatican archivist at the time) in his "Vitae Pontificum", published in 1479. Dr. Wiliams' account seems to be a very garbled copy of that of Platina. Fr. Rigge calls attention to the following facts: 1) that the pope did not issue a bull against the comet and that no such bull appears in the Bullarium Romanum; 2) that supplications were ordered, but only **conditionally, "if evils were impending"**; 3) that the pope assumed no authority over the comet, nor bad it be gone; 4) that bells were rung as a reminder to pray, not to frighten away the comet.

In conclusion, I shall quote once more from the pages of the book. On page 236, we read that Jean Astruc

> was in his own day sneered at by theologians of all creeds as a "Doctor of Medicine who had blundered beyond his province".

These words may well be applied to Dr. Williams.

Weston College,
Weston, Mass.

BOOKS

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

BIOLOGY

Taxonomy of the Flowering Plants, A. M. Johnson,
The Century Co., New York, N. Y.

Human Physiology, F. R. Winton & L. E. Bayliss,
P. Blakiston's Son & Co., Philadelphia, Pa.

Guide to Histology & Microscopic Anatomy, M. Lloyd,
P. Blakiston's Son & Co., Philadelphia, Pa.

Histology, Alexander A. Maximow,
W. B. Saunders Co., Philadelphia, Pa.

Elementary Bacteriology, Joseph E. Greaves,
W. B. Saunders Co., Philadelphia, Pa.

Developmental Anatomy, Leslie Braineid Arey,
W. B. Saunders Co., Philadelphia, Pa.

CHEMISTRY

The Vitamines, H. C. Sherman and S. L. Smith,
The Chemical Catalog Co., Inc.,, New York, N. Y.

Handbook of Chemical Microscopy, Vol. II, Chamot & Mason,
John Wiley & Sons, Inc., New York, N. Y.

Organic Synthesis, Vol. XI, Carl S. Marvel, Editor,
John Wiley & Sons, Inc., New York, N. Y.

Organic Chemistry, Revised Edition; Bernthsen & Sudborough,
D. Van Nostrand Co., Inc., New York, N. Y.

A Shorter Course in Organic Chemistry, J. C. Colbert,
The Century Co., New York, N. Y.

Carbon Compounds, C. W. Porter,
Ginn & Co., New York, N. Y.

PHYSICS

Flights from Chaos, Harlow Shapley,
McGraw-Hill Book Co., New York, N. Y.

Men and the Stars, Harlan True Stetson,
McGraw-Hill Book Co., New York, N. Y.

Electrolytic Conduction, F. H. Newman,
John Wiley & Sons, Inc., New York, N. Y.
Electricity and Magnetism, Vincent C. Poor,
John Wiley & Sons, Inc., New York, N. Y.
The Conductivity of Solutions, Cecil W. Davies,
Jon Wiley & Sons, Inc., New York, N. Y.
The Physics of Crystals, Abram F. Joffe,
McGraw-Hill Book Co., New York, N. Y.

BOOK REVIEWS

An Introduction to Chemistry, A Pandemic Text by John Arrend Timm, McGraw-Hill Book Co., 1930. 21x15 cm. pp. 551. Numerous cuts and illustrations.

The Spirit of Chemistry. Alexander Findlay. Longmans, 1930. 22x15 cm. pp. 480. 88 figures: 62 portraits and illustrations.

Both of the above texts purport to fulfill a need in our College curriculum of a course in Chemistry for the non-technical student, for the student who wants a cultural knowledge of the subject, and feels no desire for metrical or scientific knowledge. The first, by Professor Timm, of Yale, offers this "culture" in the form of a philosophy of Chemistry, a simplified Physical Chemistry, as it appears, with some brief appiications to life processes and to the industries. The second, by the author of "The Phase Rule" and numerous other texts from the University of Aberdeen, would aid the student by showing him the magic growth of Chemistry in the glamor of discovery and in the inspiration of its arduous pioneers.

Both also decry the unnecessary array of facts in our modern texts, a crazy quilt of properties and principles. Such tests, it would seem, were cast from a mold fifty years ago. For, when modern chemistry was first taught, it was taught as a mass of data, with scant correlation—a descriptive course, outlining the history of the elements, along with their properties and methods of preparation. As time went on this method of presentation was improved by interlanding laws, theories and hypotheses among the known facts. And so, our finished text book of today is like a mush-room city built along cow paths. Given, of course, plenty of time to become acquainted with its devious ways, one will finally learn its mysteries. And the technical student of Chemistry is supposed to have both the time and the patience.

But the real problem is with our students who have no urge to take up Chemistry as a profession. They are neither qualified for a technical course nor are they expected to use such in later life. "The presentation of the properties of one element and its compounds after another and the drill in equation writing and problem solving necessary and desirable though they may be for the student who plans to major in Chemistry have no place in such a cultural course". (From Introduction to Professor Timm's book).

And so Professor Timm has outlined a course whose aim is fourfold: first, to develop an appreciation of scientific procedure, second, to introduce the student to the methods of tabulation and presentation of scientific data, third, outline the theories and laws on which the structure of Chemistry is built, fourth, to treat the development of this theory historically, as far as is possible.

In "The Spirit of Chemistry", Professor Findlay prefaces his book with the statement: " . . . the purpose of the book is not so much to impart a detailed knowledge of a wide range of facts as to create a scientific spirit; a spirit of toleration and of cooperation, of intellectual adventure and of intellectual honesty, which seeks ever to enlarge our knowledge of the external world and to found that knowledge, not on tradition or authority, but on a basis of ascertained fact. It is, moreover, the aim and purpose of this book to give some understanding of the fundamental principles and concepts, and to trace the historical development of law and theory, in chemical science. By means of portraits and of thumbnail biographical sketches, also, it is sought to make the leaders in the development of chemical science live in the mind of the student, not as mere names but as human beings."

From the above aims, as professed by their respective authors, one can judge, I think, which book gives the intended "cultural course". The first, by Professor Timm, appears to suffer considerably on comparison with that of Professor Findlay. It is ridden by the "Physical-chemistry-incubus", so prominent in American Chemistries. And, in my opinion, barely escapes the category of highly technical texts. But Professor Findlay is more than a chemist. He is a scholar, who quotes from Aristotle and Virgil and Noyes and Homer and Gibbon and Shelley with equal facility. And the spirit which animates his book is a spirit of high adventure, of painstaking research crowned with success. It is an animated story told by one who is both a scientist and a poet, breathing "The Spirit of Chemistry".

JOSEPH J. SULLIVAN, S. J.,
Boston College, April 21, 1931.

NEWS ITEMS

FORDHAM UNIVERSITY. The third convention of the Associated Biology Clubs of Catholic Colleges was held at Fordham University, April 6th and 7th. These meetings were organized by the Fordham Mendel Club with the purpose of impressing upon the students the great work that was done and is being done by Catholic biologists. This year special tributes were paid to Lamarck, Cuvier and Wasmann. The delegates from the various colleges also read papers on special topics; and the discussions of biological phenomena and problems were most interesting and beneficial to all. The program was varied and scholarly. The following colleges sent delegates to the convention: College of St. Thomas, St. Paul, Minn.; University of Detroit, Detroit, Mich.; Xavier University, Cincinnati, Ohio; St. Bonaventure College, Allegheny, N. Y.; St. Anselm College, Manchester, N. H.; St. Vincent College, Latrobe, Pa.; Manhattan College, St. Francis College and Fordham University, of New York City. Further information may be had from the Secretary, Dr. John Giesen, St. Thomas College, St. Paul, Minn. Even greater success is expected from the convention to be held next year.

DEPARTMENT OF CHEMISTRY

The research problems which were in progress under Father Martin are being continued and a list of some of them might prove of interest.

In Physiological Chemistry, under the direction of Dr. Sherwin, the following problems are being investigated:

Further work on the Detoxication of Phenylacetic Acid. (A report on the progress of this work was presented at the Spring meeting of the American Chemical Society which was attended by Dr. Sherwin and Fr. Power).

Investigation of the Detoxication of para aminophenol and para acetylaminophenol.

A Study of the Effect of Glutathione on the Metabolism of the Rabbit.

A Study of the Proteins present in various varieties of Fur.

In Organic Chemistry, under the direction of Dr. Bacharach:

A Study of certain dye stuffs of the Benznaphanthrone series.

The Properties and Preparation of certain Nitro acridones prepared by the use of Metallic Nitrates and Acetic Anhydride.

Studies of Nitration of various Aromatic compounds by this same method e. g. Nitrosalicylic Acid Nitrotoluidines.

The use of Metallic Nitrates in Acetic Anhydride for preparing Aliphatic Nitrates.

The use of Metallic Nitrites instead of Nitrates in these various reactions.

The systematic study of the mechanism and product of the reduction of Nitrobenzene and Nitrotoluene with alkaline glucose solutions.

Studies on the mechanism and reaction product of modified Grignard reagents.

CANISIUS COLLEGE. The Ninth Annual Scientific Symposium, held under the joint auspices of Canisius College, the University of Buffalo and the Buffalo Museum of Science, was held on the evenings of April 23, 24, 25 in the auditorium of the Museum. The Rev. James B. Macelwane, S. J., St. Louis University, was the speaker, and his subjects were:

April 23 The Nature and Effects of Earthquakes.
April 24 Earthquake Waves and Seismographs.
April 25 The Structure of the Interior of the Earth.

Under the auspices of Canisius College and the Buffalo Museum of Science, Dr. William Braid White, Director of Acoustic Research, American Steel and Wire Company, Chicago, gave a public lecture at the Museum, April 17th, on the subject, "Is Noise Scrambled Music?" The lecture was enthusiastically received. Dr. White was school-mate with G. K. Chesterton and Hilaire Belloc. Dr. White came to Buffalo on the invitation of Fr. Delaney for the purpose of analyzing the musical note clearly audible at Niagara Falls.

The Monthly Bulletin of the Seismic Observatory, Canisius College, is now mailed to 290 observatories in all parts of the world, through the courtesy of the Central Station, Jesuit Seismological Association. The Canisius Bulletin, which began with the January number, has brought many gratifying comments.

A communication from Science Service, dated February 14, congratulates Canisius College on the promptness of our earthquake reports. "You are the newest station on our reporting list, and, it begins to appear, the quickest about sending in your data. For the last three or four earthquakes, the Canisius College wire was the first to come in."

A note from Dr. Karl F. Herzfeld, Professor of Physics,, Johns Hopkins University, congratulates Fr. Delaney on his recent Einstein lecture at the Buffalo Museum of Science. Dr. Herzfeld writes: "I admire very much the work which you do in Buffalo popularizing Physics. Indeed your presentation (of Einstein) seemed to be much superior and more complete than mine."

BIOLOGY DEPARTMENT

Several new demonstration charts have recently been added to the department's growing collection. With these charts and the laboratory models as his visual guides, the student is expected to make more accurate dissections and eliminate needless recourse to the instructor.

Mr. Wahl and the laboratory instructors are now engaged in the work of augmenting the number of embryological slides. During the earlier part of the year their efforts were rewarded by the addition of several hundred special histological slides.

CHEMISTRY DEPARTMENT

Preliminary meetings have been held for the organization of a Chemistry Club which will actively function during the 1931-1932 scholastic year.

A seminar on some recent discoveries in the field of the Chemistry of Food and Nutrition will be given by the students of this course on May 22nd.

LOYOLA COLLEGE, Baltimore, Md. Dr. F. O. Rice, Associate Professor of Chemistry, Johns Hopkins University, lectured to the Loyola Chemists' Club on April 15, his subject: "Chain Reactions".

On April 22, Mr. L. W. Schanks of the Ethyl Gasoline Corporation gave a lecture and demonstration of the use of tetra-ethyl lead in motor fuel. The American Sugar Refining Co., contributed a set of forty-two samples of their products to the chemical museum for lecture demonstration. — The thesis of Mr. E. S. Hauber, S. J., Professor of Physical Chemistry, was printed in the March number of the Journal of the American Chemical Society. — A series of experiments in gas analysis were introduced in the course of quantitative analysis. — A new motor-generator set was installed in the Physics Department.

HOLY CROSS COLLEGE—DEPARTMENT OF PHYSICS.

On Wednesday, February 18, Rev. Henry Brock, S. J., gave a most interesting lecture here to the members of the Scientific Society. His subject was "The Photo-electric Effect and its Application to Television, the Talkies, and the Sending of Pictures by Wire". The lecture was illustrated by a number of interesting experiments, and by slides.

During the month of March, Professor Hobart H. Newell, of Worcester Polytechnic Institute, gave to the members of the Scientific Society two lectures. Mr. Newell is Radio Engineer for Station WTAG in Worcester and he explained in a facinating manner the whole broadcasting process, the difficulties that are met and the methods employed to solve them. After the lecture the members of the Society fairly bombarded Professor Newell with questions all of which he proceeded to answer in a clear, interesting manner. Mr. Newell afterwards remarked on the intelligence of the questions and stated that it was a real pleasure to lecture to a group so clearly interested in radio.

While visiting Worcester Polytechnic Institute recently, Professor Newell showed a rather spectacular experiment, lighting an electric lamp with a match as one would light a candle and then extinguishing it, as one would a candle, simply by blowing on the filament. (Since the filament or glower is composed of oxides, it is not necessary to seal it in a bulb).

The principle of the lamp of course is clear. The circuit is closed but the resistance of the filament is too great when cold to carry a current. Hence it must be first heated with a match. When hot its resistance decreases and a sufficient current can pass through it, to avoid too great a current which would be apt to flow when the filament reaches white heat a protective resistance must be placed in the circuit. To extinguish the lamp one has merely to blow on the filament which, as it cools, increases in resistance to such a degree that it will no longer carry a current and the circuit is broken.

(This lamp is described in Robinson's Elements of Electricity, 3rd Edition, Revised, page 401).

DEPARTMENT OF CHEMISTRY

The Administrative Board for Graduate Studies announces the appointment of the following Fellows in Chemistry for the scholastic year 1931-1932: Mr. Gerard M. Landrey, S. J., Weston College, Weston, Mass.; Mr. Pierre A. Kleff, B. S., Loyola College, Baltimore, Md.; Mr. Fred J. Delmore, A. B., St. Thomas College, Scranton, Pa.; Mr. Wayne L. Besselman, B. S., Holy Cross College, Worcester, Mass.; Mr. Fred. W. Richter, B. S., Fordham University, New York City; Mr. Hartley W. Howard, B. S., Georgetown University, Washington, D. C.; and Mr. Edward L. Rodowskas, A. B., Loyola College, Baltimore, Md.

WESTON COLLEGE. Rev. M. J. Ahern, S. J., was appointed Chairman of the Committee in charge of a series of chemical radio talks sponsored by the Northeastern Section of the American Chemical Society. The introductory lecture was broadcast by Father Ahern over stations WNAC, WEAN and WICC on Thursday afternoon February 19. These radio talks on popular chemistry were given each Thursday until April

9. — Father Ahern gave an address at the dinner preceeding the January meeting of the Northeastern Section of A. C. S. His subject was: "Jesuits, the Discoverers of Quinine".

Three Scholastics, who taught science, will be ordained to the Priesthood in June: Messrs. Thomas H. Quigley, Thomas J. Smith, and Thomas D. Barry. — Recently Mr. Austin Devenny, S. J., gave a lecture and demonstration: "Some Methods of Sound Reproduction." Mr. Edward Hogan, S. J., read a paper: "Some Methods of Nitrogen Fixation".

WOODSTOCK COLLEGE. Among the "Ordinandi" for this year are the following scientists: Messrs. G. Kirchgessner, E. Nuttall, J. Hearn, H. Pollet. One of the most interesting and instructive lectures ever heard at Woodstock was given recently by Mr. Odenthal, of the Bell Laboratories. Entitled "Sidelights on the Telephone Industry" the lecture outlined the research work of the Laboratories and by means of a number of reels of excellent talking pictures illustrated the application of their findings to such industries as the talking movies, airplane lines, etc. The lecture may be obtained through your local Telephone Company. — Illustrated lectures on moths and butterflies and on tree-flowers were given by Fr. J. Brosnan; on the wild flowers of Woodstock by Mr. Harley, others on birds and fungi will follow in the near future. — The biology paper at the Philosophers Disputation was on Mendelism given by Mr. Joseph Lynch. Negatives for the slides used in this lecture illustrating the two fundamental principles of heredity contributed by Mendel may be had from Fr. Reardon. — The equipment of the chemistry laboratory has been completed by the addition of a third large chemistry table of the standard type. — It is hoped that the fine collection of museum specimens that have been hidden from sight these many years will soon be housed around the walls and balconies of the old library. The proper display of these specimens will be a fitting memorial to the humanism of the Italian founders of Woodstock. — Two seismographs donated by Georgetown have been installed by Messrs. Tynan and Gorman in the basement of the Theologians wing near the private biology laboratory started last year for Theologians.

BOSTON COLLEGE—DEPARTMENT OF CHEMISTRY

During the week of April 13th, the winners of the five competitive Fellowships in Graduate Chemistry were announced. They are the following, all from B. C.: Gaetano F. D'Alelio, A. B., '31; Thomas W. Crosby, B. S., '31; Salvatore Palmieri, B. S., '31; John F. Powers, B. S., '31; and John T. Ryan, B. S., '31. These were chosen from numerous applicants from Colleges as far south as New Mexico and as far west as Oregon.

On Thursday, April 29, 1931, Rev. Joseph J. Daley, S. J., who has been doing research work on radio transmission and amplification for many years, gave a remarkable demonstration of his new patent before a distinguished audience. It is a new scientific principle for the amplification of radiant energy as applied to radio with no regeneration. Cf. article in this issue.

REGIS HIGH SCHOOL, New York. Regis Pasteur Chemistry Society.

The Society commenced its second year of existence under the guidance of Mr. Thornton. The weekly meetings held on Friday are opened with a brief period given to ordinary business matters; secondly, one of the members gives a short talk or reads a lecture on some subject of interest to all; next, the Moderator or some outside speaker gives a lecture on some pertinent topic; and lastly, the members are given an opportunity to ask questions and discuss the topics presented.

Some of the topics already presented are "Insulin and Its Relation to Diabetes, and to the Metabolism of Carbohydrates and Fats"; "Helium"; "Slate and Glass Blackboards"; "Allotropic Forms of Carbon"; "Chemistry and its Importance in Medicine"; "Chemistry and the Vitamins"; "Manufacture and Use of High Explosives"; "Dyes and Dyeing"; "Chemistry and the Drug Industry".

During the past month the members of the Society have been rehearsing particular experiments in preparation for the Chemistry Demonstration to be held in the School Auditorium on April 29th. This, the most important event of the year, is to include experiments conducted by the members; among these experiments are the explosion of hydrogen and oxygen, the burning of phosphorus under water, and a variety of color-change experiments. In addition, there will be a lecture on "Chemical Warfare" by Dr. Leo K. Yanowski, Professor of Chemistry at Fordham University. He is an officer in the Reserve Officers Training Corps, Chemical Warfare United, 2nd Corps Areas of New York City. He is to demonstrate the latest U. S. Government Gas Mask which employs the new telephone diaphragm, permitting speech and conversation without necessitating the removal of the mask. To conclude this demonstration there will be a lecture and experiment on the properties of liquid air conducted by the Society's Moderator, Mr. Thornton.

LOYOLA HIGH SCHOOL, Baltimore, Md. At the entrance examination to the Naval Academy at Annapolis one of the Loyola students received 100% in geometry and 93% in algebra.

BROOKLYN PREPARATORY. The "Research Club" in Biology is now experimenting with the effects of various chemicals on guinea pigs. — A public demonstration was given to other students on dissection. The lecture given by Mr. Francis N. Wedder was attended by a large number of students and held the attention of all. Recently two sets of biological movies were shown to the members of the Club; one set showed the preparation of the sutures, and the other explained the surgical application of these sutures. — The purpose of the "Research Club" was accomplished and it reports a very successful scholastic year.

MANILA OBSERVATORY, Manila, P. I. After two years, the mysterious cause of the failure of the eclipse photographs taken with the seven meter camera at the eclipse of the sun May 9, 1929, has come to light. Upon attempting to use the four inch protovisual lens as the objective of a guiding telescope for the 19 inch equatorial, it was discovered that the image given by the lens was wretched. This was not discovered before, since the lens arrived just one week before the party left for Cebu, and the only examination of it that could be made was by the image on the ground glass; hence the defects of the image were attributed naturally to light scattered by the ground glass. Recently upon further examination by taking apart the objective, it was found that the manufacturer had sent the objective with two of the lenses facing wrongly. Placing the lenses in their correct position, the resulting image is excellent; the eclipse however is gone and cannot be brought back.

BOLIVIA, South America. The Grand Cross of the Condor of the Andes, Bolivia's Highest decoration, has been conferred upon Rev. P. M. Descotes, S.J., in recognition of his twenty years scientific work for the benefit of his country. He is head of the San Calixto Observatory at La Paz. Father Descotes had previously declined to receive any decoration. This time, however, when his Superior summoned him to his room he found the Government Officials waiting to present him with the decoration.

CHINA. Rev. Augustus Savio, S. J., of St. Ignatius College, Shanghai, has been nominated Professor of Entomology in the Chinese State University of Agriculture at Woosung, near Shanghai. Father Savio is widely known both as a scientist and as an apostle of youth. He is a member of the Society of Entomology in France. He had to decline another college appointment offered him by the Nanking Central Government.

Rev. Teilhard de Chardin, S. J., took part in the Central Asiatic Expedition, which discovered numerous relics of a totally unknown mastodon. Father Chardin also collected the documents which will help him to make a useful connection between the geology of China and the geoogy of Mongolia.

Rev. Emil Licent, S. J., authority on archaeology, and Director of the Hoangho-Paiho Museum of the Catholic University of Tientsin, recently addressed Japanese archaeologists in Kyoto and Tokyo, Japan. The invitation was sent by Marquis Hosokawa, President of the Far Eastern Archaeological Society. In Kyoto, Father Licent spoke of his palaeolithic finds in North- Eastern China, and in Tokyo of his neolithic researches.

TENTH ANNUAL MEETING

OF THE

AMERICAN ASSOCIATION

OF

JESUIT SCIENTISTS

AUGUST 1931.

WANTED: BACK NUMBERS

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of the

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Proceedings of Sixth Annual Meeting 1927.

Send to the Editor: LOYOLA COLLEGE,
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Baltimore, Maryland.

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