D. O'Donnell, S.J.

S.J.B

A. M. D. G.

BULLETIN

of the

American Association of Jesuit Scientists

(Eastern Section)

For Private Circulation

LOYOLA COLLEGE
BALTIMORE, MARYLAND

VOL. X DECEMBER, 1932 NO. 2

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EASTERN STATES DIVISION

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EDITORIAL

Truly these are days of economy. These are days of sacrifice and adversity. Many aspirants to college education are disappointed and keenly feel the misfortunes of circumstances. Adverse conditions in finances have brought about a corresponding effect in education. This is evident from the increase of burdens that are added to long standing deficiencies in educational programmes and prospects. Even though, in some cases, there is an increased enrollment in our educational centers that is partly due to unemployment, still the revenue from tuition has usually decreased. This requires a greater variety of subjects in the curriculum and hence imposes an increased financial responsibility. These conditions require better methods of teaching and better management in our schools.

Curtailment in the financial budgets of the various departments of education should show us ways and means of reorganization, so that extravagance is eliminated and economy practised, while at the same time the essential good features are maintained. *'Necessity is the mother of invention,'*—and adversity may bring us many benefits.

Adversity may come in many different ways. Recently the shocking news reached us, telling of the destruction of the Ateneo de Manila by a devastating fire. The entire College and High School were destroyed and the splendid equipment of the science departments—a total loss. This equipment in all the various departments was modern and up-to-date; and the standards of education were excellent. Now they suffer a severe blow and greater adverse conditions confront them, which require adjustment and reorganization. With the experience of the past and the knowledge of the present, the new reconstructed science departments of the Ateneo de Manila will be the finest and most modern in the Far East. Because of circumstances, progress will be slow, however—this is not a disadvantage for reestablishing a well-known educational institution.

The members of the American Association of Jesuit Scientists would extend a helping hand across the Pacific to a temporarily crippled college by donating books and apparatus. These are the tools we work with,—and without these tools little can be accomplished.

It is our sincere desire that the New Ateneo de Manila may be greater than ever; may its high standards of long standing be maintained; may it advance in adversity.

R. B. S.

THE LONERGAN SCHOOL OF MECHANICS
ST. JOSEPH'S COLLEGE
PHILADELPHIA, PA.

Rev. Thomas H. Moore, S.J.

These notes on the new Physics Building at St. Joseph's College were written the evening of October 24, 1932. At that date the contractors were preparing to pour the second floor. The stone work had just about reached that floor. If the weather is favorable we hope to be in the building some time in February.

Let us run ahead to that date and go through the building.

As we walk from 54th Street towards the College on City Line Avenue the new building is hid behind the present Gothic structure and will not come into view until we are past the Cardinal's Residence. We find the building facing the Avenue, as does the present school, but set back a building's width from the line of the older structure which is very close to the Avenue. Great care has been taken to match the Gothic style and stone design which every one so admires in the main building.

We can get into the basement by entering the west door and going down the fire-tower steps. The original plan, drawn at the time when the old building was designed, called for no basement under this part of the complete plant because the excavation material was solid rock. Instead, a small wing was to project from the far end of the building towards the Avenue, running out to a point on a line with the front of the other edifice. This wing was sacrificed in favor of a basement, the argument being that a wing could be added at any time but once the building was up it would be impossible to put a basement under it.

From the foot of the fire-tower steps we can look along the corridor the entire length of the building, 150 feet. The rooms are all on the right of the corridor. And this plan of construction was followed on each floor because it put a corridor between the class rooms and a rather popular automobile way.

The first room in the basement at the west end is a work shop fairly well equipped with bench lathe, grinder, drill, etc. Next to it is a Stock Room which will supply the Light Laboratory adjoining it on the other side. There are three Stock Rooms in the school, one above the other, and the electric elevator in the corner of this room runs through to the Stock Rooms above.

Next to the Light Laboratory is a two-room Dark Room, which is artificially ventilated. The rest of the basement space is given over to a store room and a book store. At the east end we can go into the old building and mount to the first floor.

The first room coming back along the first floor is a Faculty Dining Room. This of course is temporary. Moving westward along the corridor we come into the main Hall and Entrance with its row of bulletin boards facing the steps which lead to the outside. A little farther along the Hall is an entrance to the Main Laboratory.

There are twenty-three tables in the Main Laboratory, fourteen of them coming from the old department. The new tables are located around the walls. They are three feet in height and of varied lengths as wall and window space permitted. Tables which occur at windows are built into the sill. All tables in this room are equipped with gas and A.C. The partition between the room and the corridor is free of tables so that the space may be devoted entirely to wall apparatus. This Laboratory is not quite as large as our present laboratory in the basement of the old building but because of the wall tables and the available wall space it will accommodate about twice the number of boys.

The rest of the floor is devoted to a Stock Room and General Office.

We can now go up the fire-tower steps to the west end of the second floor. The end room is the Office of the Head of the Department. Next to it is the third Stock Room which feeds the Lecture Room adjoining it on the east.

The Lecture Room was a real problem. We wanted a large one, nearly square and with the amphitheatre seating arrangement. Where were we to put it in a building only fifty feet wide and eight feet out for a corridor? An end room would eliminate the corridor. But at one end of the building we had a fire tower, which is required by law, and at the other end there was the tie-in with the other school building. We solved the problem by setting the Lecture Room in the middle of the building with the seats facing south towards the Stadium. The seats then rose from floor level on the south side to a nine foot level on the north; and we ran the corridor right under the room at this elevation.

This arrangement afforded ample room for 166 tablet arm, sanitary pedestal base seats. But in solving our seating problem we ran into difficulty with the lighting. The windows are at the front and back of the room instead of on the sides where they would do the most good. It will be necessary to permanently curtain the front windows and use electric light. We can console ourselves with the thought that, with the light curtained off at the front, the Lecture Room resembles very much the main Lecture Hall at M.I.T.

All the lighting in the room is controlled from the Lecture Table by a master switch. Flood lights for the Lecture Table together with the ventilating fans are also controlled from the table.

The room is well equipped and wired for sound movies; the walls and ceiling are faced with acoustic-celotex and connections have been made from the Radio Room to the Lecture Table for broadcasting purposes. The room has four exits, one at each corner.

The southeast exit will lead directly into the Electrical Laboratory which will also be used for experiments in Heat. The equipment in this room is entirely new, the main feature being the D.C. electric panel which services all tables in the Electrical Laboratory, the Lecture Room Table, the Stock Room Preparation Bench and the Radio Room. At these points D.C. current in two volt stages up to 110 volts is available. The batteries are concealed beneath the table at the corridor end of the laboratory.

The last room on this floor is the Radio Room. The third floor is devoted to four general class rooms and an office.

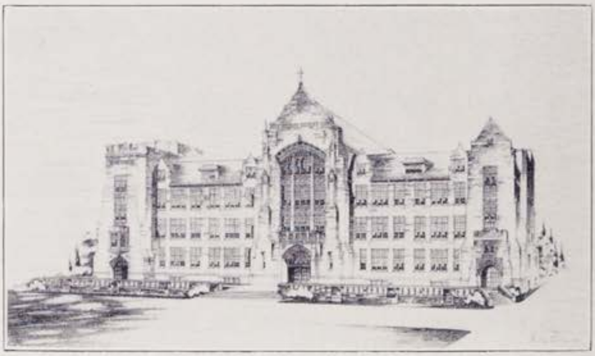
Now to the roof. The building is Gothic and consequently the roof is well arched. But where the tie-in with the old building occurs the roof is flat. This section has been railed off and will serve as a small roof garden. It is our intention to mount a three-inch telescope on this site and I mentioned that fact to the reporter who covered the building for the local papers. The papers picked on this telescope idea as a special feature and it went into the headlines as a "laboratory for astronomical observations."

Keeping in mind that our aims are strictly undergraduate, we feel that the School of Mechanics will give us every facility compatible with an institution of our size. After all, the worth of a laboratory depends primarily on the apparatus with which it is equipped. But it also depends in great part on the facility with which this apparatus is serviced. Every effort has been made, for example, to locate water, gas and electrical outlets wherever they may be of use. The suggestions and criticisms of our science teachers and those of other schools were invaluable aids in solving the question of what would be most serviceable. We take this chance to thank them for their generous help.

The building is being constructed by McCloskey and Co. of Philadelphia, who also built the new Novitiate at Wernersville. The Laboratory equipment, tables, cases, shelves, chairs, etc., is being furnished by W. W. Kimball and Co. of Chicago. Mr. Sigmund Leschenski of Philadelphia is the Architect.

GEORGETOWN UNIVERSITY
WHITE-GRAVENOR BUILDING

The White-Gravenor Building, newest unit of Georgetown's Andrew White Memorial Quadrangle, is rapidly nearing completion according to a statement made by the President of the University, the Rev. W. Coleman Nevils, S.J., who said that the newly constructed building would be completed by January 15, and occupied about February 1, a date which coincides with the opening of the second semester. Fr. Nevils said that this would relieve the congestion in the Chemistry Department, at present under the Healy building, and permit the establishment of the Law School at the Hilltop as well as permitting the expansion of the Foreign Service School which just this year has been established in the Healy Building.



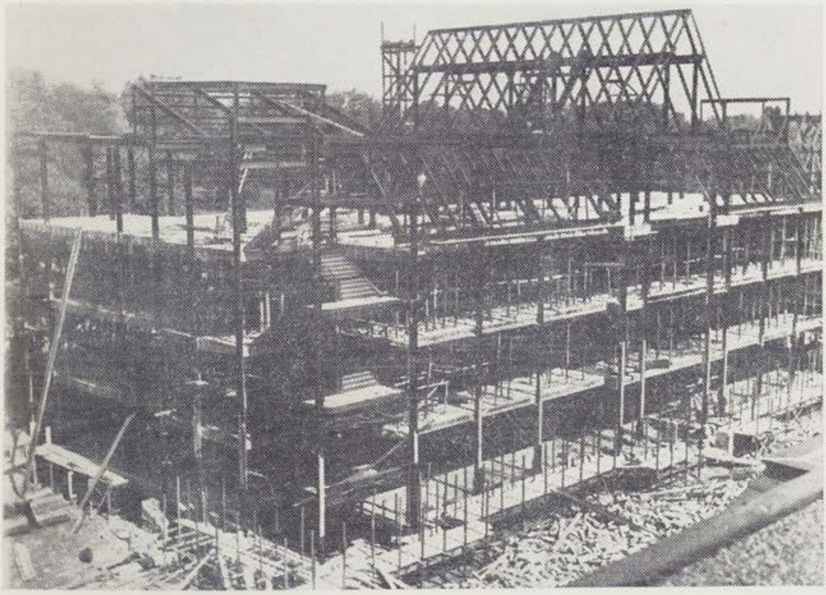
Architecture

The architecture similar to that in which Copley building was built will be in the Neo-Gothic Scholastic manner and will be fronted by an esplanade 190 feet long by forty feet in width upon which stone terrace it is hoped that all future graduations will be held. This esplanade will be surrounded by a railing of carved stone 4 feet high. Beyond this balustrade spotlights will be located in such a manner that they may be thrown on the front of the building, making it a thing of beauty at night. At the main entrance one may see upon entering a huge rose shaped, stained-glass window commemorating the first Mass said in America on March 25, 1634, by an English speaking priest. The main archway is already in process of erection in respect to the stone work, the structural steel having been put in place previously.

The first floor of Gravenor Hall will be occupied by the offices of the Dean, Registrar and Recorder of the College of Arts and Sciences, while beneath these offices the basement will contain a fireproof safe which will be used expressly for the storage of scholastic records of the University. In addition to the safe, the basement will contain large locker rooms for the Foreign Service and Law students while a cafeteria will be placed in operation for the purpose of serving students who will study in the two professional schools. The first floor in addition to the official offices named previously will also contain a senior lecture room capable of seating 225 students as well as private offices for the professors of Psychology and Ethics. Faculty lounge and study rooms will also be on the first floor, along with three reception parlors, and a general reference library for those who care to study during unoccupied periods.

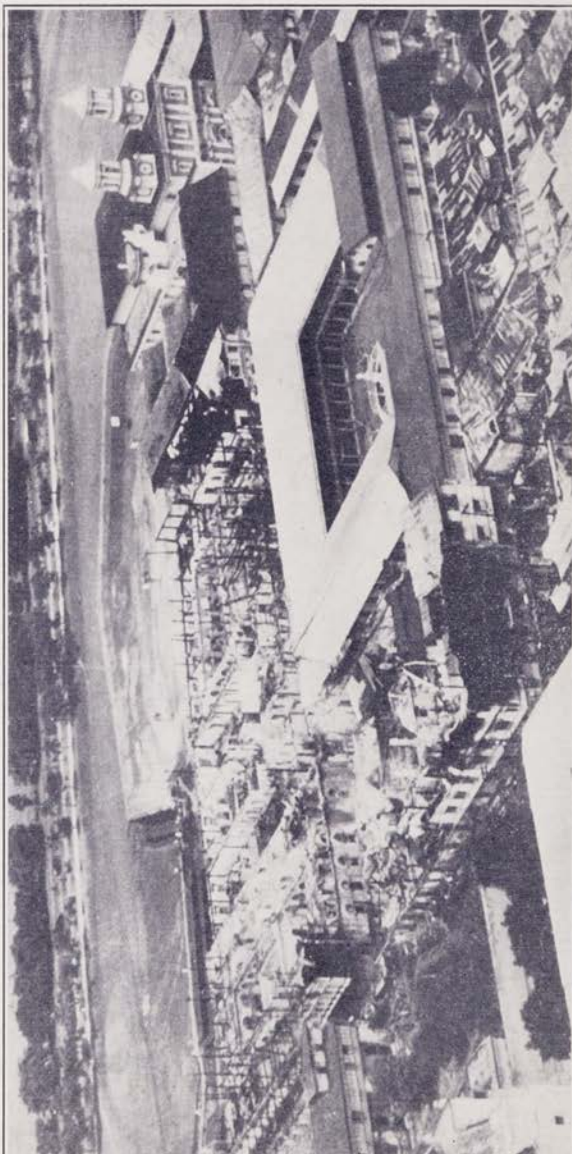
Chemistry Departments

The second and third floors will have class rooms and the middle south rooms on each floor will be lounges for the use of the students. On the top floor will be the entire Chemistry department of the hilltop under the direction of The Rev. Fr. George F. Strohaver who is engaged in determining



the layout of the equipment which will be of the most modern character. The equipment and lecture space will be contained in two large class rooms and four laboratories. The attic will be a chemistry reference library, a chemistry faculty room and a separate office for the head of the department,

(Continued on Page 99)



Airplane View of the Ruins

SCIENCE DEPARTMENTS OF ATENEO DESTROYED BY FIRE

On the night of August thirteenth while a basketball game was being held in one of the Ateneo patios and bed time for the boarders had been put off until a later hour, the general interest of the spectators was suddenly diverted by the din of fire apparatus and a brilliant illumination in the sky over the patio. In a minute the patio was deserted. All the fathers and boys hastened to the roof of the old Mission House for a good view of the fire.

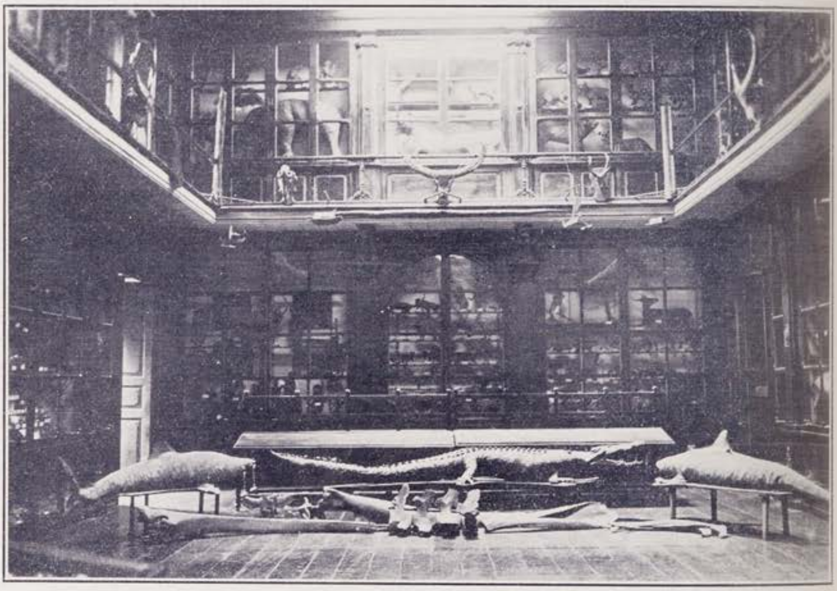
It had started in a hat store on Real Street, three short blocks from the Ateneo. While the flames leaped high and lashed furiously at neighboring buildings no one suspected that the famous old Ateneo was awaiting its doom. The first alarm had been sounded at 9.15 p. m. and in the course of the three quarters of an hour following, the fathers on the roof of the Mission House watched the flames die down three times, giving the appearance of being under control. But when the conflagration burst out anew through the roof of Santa Isabel college across the street from the Ateneo and then swept into the Bureau of Public Works' building next to our college, the utter hopelessness of the situation was quickly realized but too late to do anything for the Ateneo.

Though the whole district was in darkness because the electric power lines had been burned down the few students who had retired early abandoned the dormitories and all their belongings in perfect order. All the fathers were immediately stationed at the stairways and entrances to prevent any boys from trying to reenter the building. It was well that this precaution was taken for at 10 p. m. the partition between the Bureau of Public Works and the Ateneo collapsed and the flames swept through the entire building in less than a minute. No attempts to salvage the valuable specimens in the museum and in the Physics and Biology laboratories were made. The fathers who lived in the college building did not even have time to save their own things.

A timely shift in the wind which forced the flames back over the ruins of the government building saved the Mission House and Saint Ignatius church. The fire department was helpless in trying to cope with such a widespread conflagration, and with poor water pressure and a broken down pumping engine matters became even worse. The Augustinian monastery which was also attacked when the wind changed was saved by the American soldiers from a neighboring barracks, who broke in the roof and left only the massive stone walls to defy the flames. Within an hour the entire district about the Ateneo and the college itself had crumbled into a pile of shapeless wreckage.

The Manila Observatory became the haven of refuge for the Ateneo boarders. Thither they went in pajamas, basketball suits, and whatever they happened to be wearing when the order to leave the building was given. A hundred or more camp cots that had been stored in the attic of San Jose for a long time were hauled down and the tired and nervous boys were soon trying to make the best of a bad night in the spacious corridors of the Observatory and Seminary. All night quite forgetful of their own heavy losses of clothes and books they lamented the loss of their school.

The fire had razed through the Ateneo at ten o'clock Saturday night. Sunday morning at ten o'clock, Very Rev. Fr. James T. G. Hayes, Superior of the Mission, Rev. Fr. Richard A. O'Brien, Rector of the Ateneo and a dozen or more of the fathers were in conference in the Observatory as to what to do. The resolution was, "to carry on". By noon the decision



THE SCIENTIFIC MUSEUM TOTALLY DESTROYED

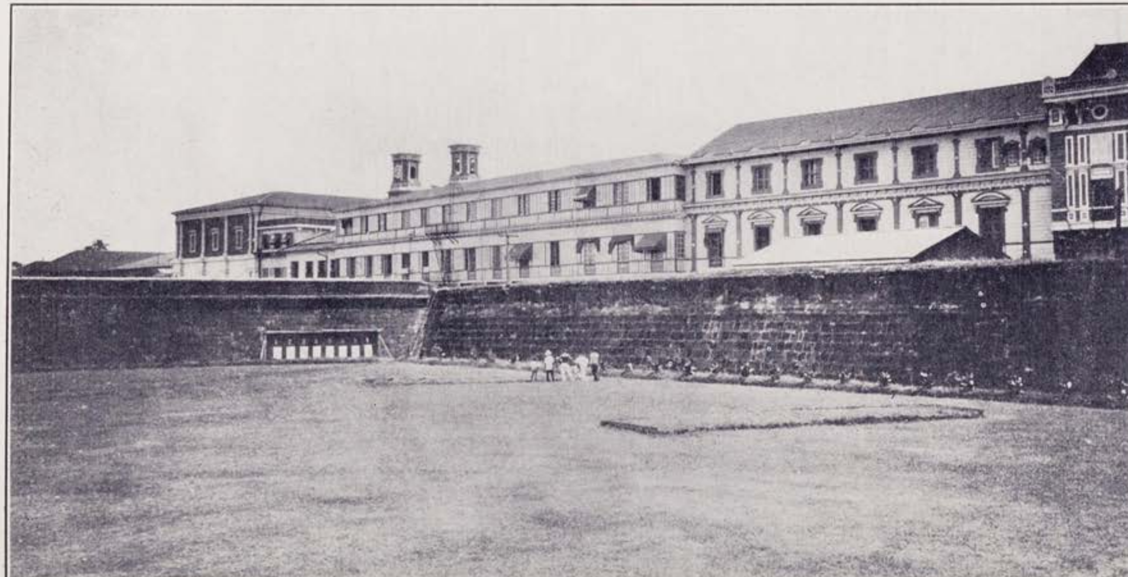
was taken, the necessary arrangements made with Mr. Buckisch, Director of Private Schools and Doctor Alyandro Albert, Under-secretary of Education, and the word was ready to be broadcast that the Ateneo would open at San Jose Seminary in one month. In the meanwhile the Seminaries and Novices were to move to other houses in Manila. The whole Filippino people had been shocked at the news of the fire which destroyed the historic Ateneo. This college had a place in the heart of every Filippino because it is the Alma Mater of Doctor Jose Rizal, the George Washington of the Philippines. When the news that the Ateneo would carry on was announced, people gasped. Impossible they thought. But the impossible was already planned and conquered in the determination of the Ateneo faculty.

The big question that was bothering every Ateneo boarder on that morning after the fire was answered in the boys' dining room after dinner. A month of vacation was granted and all were to return for classes on September nineteenth. For the first time in almost fifty years the quiet novitiate walls trembled with the rythm of an Ateneo cheer. The spirit of the students was marvelous. Said they, "Fire may destroy the Ateneo building but it only makes the Ateneo spirit burn brighter". Faculty, students and alumni have all worked with a will. We also feel that any who read these lines will want to help us in some way and hence we are emboldened to enter upon a brief description of the big rehabilitation program that has been undertaken especially by the science departments.

Mr. Guicheteau, Professor of College Physics, and Father Reardon, Professor of Biology have shouldered heavy tasks. A resume of the losses of both departments showed a total of more than 45,000 pesos for Physics and more than 15,000 pesos for Biology. These two departments have always been the pride of the school and much of the destroyed equipment can never be replaced. Only the immediate essentials for both departments can now be obtained and then the careful labors of all the professors of the past twenty five or more years must begin all over again.

Four single story buildings, mere frame structures on the new Ateneo campus were hurriedly completed during the month of grace granted by the board of Private Education. One of these was immediately occupied by the Chemistry department which fortunately was saved from the fire. Another containing a ninety foot laboratory, a private laboratory, lecture room and reading room was given over to college Biology. A slightly smaller building, with the same arrangement of laboratory and lecture room has been devoted entirely to high school Biology. The new Physics building contains a dark room for light experiments, a large laboratory with ten tables and two lecture rooms for high school and college. The instrument cabinets, lecture desks and laboratory furnitûre were made in Manila. All table tops were given a coating of acid proofing by some of the fathers in charge. The science professors now agree that their present quarters are more airy and brighter than those in the old Ateneo. All the new furniture and equipment can be readily adapted to a new science building when it comes into existence.

Mr. Guicheteau and Father Reardon worked day and night for two or more weeks drawing up complete lists of new apparatus for their laboratories. Every morning they discovered some little article that had been overlooked and every night they retired realizing that some things were still wanting. With plans for new buildings, furniture, future lectures and new apparatus combined in one entangled problem the whole business of rehabilitation was by no means restful. Finally memory, catalogs and suggestions could add no more to their lists, and the orders were ready. After three months of patient waiting and ingenious contriving the new laboratories should be well equipped.



The Ateneo de Manila Before the Fire

But Biology and Physics still find themselves at a loss for reference books. Several hundred priceless volumes than can hardly be entirely replaced were lost. There are but few booksfores in the Philippines and none where good reference books for the sciences can be plentifully obtained. Many of the desired books are now out of print and others almost too expensive for rapidly dwindling funds. The Physics department must rely on the generosity of other colleges for copies of their laboratory manuals which were very useful to the professor in preparing experiments. Both departments will greatly appreciate any assistance that other colleges can offer toward the replacement of their reference libraries. While we all realize that the times are not propitious for such requests we also feel that some of our sympathizers will try to help us in some way. The matter of books seems to us the most practical and the cheapest and easiest for shipment. Perhaps the professors of the sciences in our colleges can interest their students in a bit of real Apostolic work for the fathers in Manila.

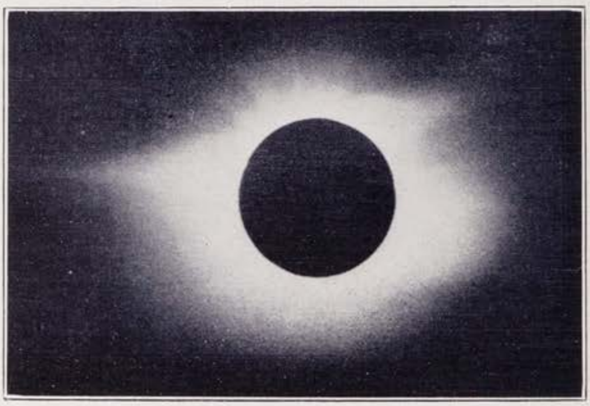
The losses of the Ateneo were very great and yet if the labors of over seventy five years are to be rescued from still greater losses the Ateneo must cope with the rivarly of the non-Catholic institutions in the Philippines. To do this well its science departments must be first class. It is hoped that the new Biology and Physics departments will place the Ateneo in a still higher rank. The self sacrifice of the present professors and other members of the faculty in the present crisis will surely win that favor for the Ateneo and the entire Philippine Mission.

GEORGETOWN UNIVERSITY EXPEDITION TOTAL ECLIPSE OF THE SUN AUGUST 31, 1932

WALTER J. MILLER, S.J.

Now that an experiment unique in the scientific annals of Georgetown University has achieved success where many failed, it is very pleasant to muse over our experiences and then tell the story to our Jesuit readers.

Doctor Paul A. McNally, S.J., Director of the Georgetown University Astronomical Observatory, was first on the scene of the solar eclipse when, four months beforehand, he picked out a site for our camp at Fryeburg, Maine, an inland town of 800 inhabitants on the central line of the eclipse. Fryeburg was chosen also by Lick, Michigan and seven other expeditions. That done, intensive preparations had to be made before the expedition could leave Washington.



On August 2nd, Father Thomas D. Barry, S.J., and Father McNally arrived by motor, and on the next day came most of the instruments, previously packed up and shipped from the Georgetown Observatory. In two or three weeks all the dramatis personae had appeared on the scene, until we numbered eleven Jesuits in a town that possessed only two Catholics. The name of the members in order of arrival are:

Father Daniel J. O'Connell, S.J., an Irish Jesuit taking a biennium at the Harvard College Observatory before assuming his duties as Assistant Director of Riverview College Observatory, Sydney, Australia.

Father Emeran J. Kolkmeyer, S.J., Head of the Georgetown University Physics Department.

Father Thomas H. Quigley, S.J., candidate for a Doctorate in Physics at Johns Hopkins University.

Mr. Walter J. Miller, S.J., Assistant in the Georgetown University Astronomical Observatory.

Father Joseph P. Merrick, S.J., Head of the Holy Cross College Physics Department.

Father Thomas J. Smith, S.J., Professor of Physics at Weston College.

Father John W. Stein, S.J., Director of the Vatican Observatory and the Pope's representative at the Congress of the International Astronomical Union held at Harvard after the eclipse.

Father Frederick W. Sohon, S.J., Director of the Georgetown University Seismological Observatory.

Father Edward S. Swift, S.J., of Boston College High School.

When the only Jesuit community in Maine had reached its maximum, our tiny cottage was jammed to the doors. Every possible courtesy was shown us by the owners, and we were invited to make ourselves at home in our use of the house and grounds. Daily Mass was celebrated by the priests on two portable altars erected on convenient bureaus. During our stay in Fryeburg over 110 Masses were said by the Fathers of the expedition.

Much hard work had to be done before a single test plate could be taken. First came the ingenious construction of a dark room in one corner of a prosaic, abandoned hen-house. The next task was the erection of a reenforced-concrete pier, a north-south line having been run the previous night by the "Azimuth of Polaris at Any Hour Angle Method". Ground was excavated in the form of a cross, with one arm in the direction of the meridian. Unbelievable amounts of sand, stone and cement finally succeeded in filling the concrete form. Next, the iron base of the telescope was securely bolted on to the 44° sloping top of the pier.

The five inch visual telescope had been previously equipped by Fecker with two astrographic cameras of two foot and five foot focal length respectively. The telescope had a motor drive for accurately following the sun, and a slow-motion motor drive for fine adjustment. Both cameras had 3½ inch Ross lenses, which give undistorted star images to the very edge of an 8 x 10 inch plate. In the forty foot camera loaned by Lick to the Michigan expedition at Fryeburg, the ratio of the five inch aperture to the focal length was 1 to 96, giving a very slow camera, at its best with a 30 second exposure. Our cameras having a ratio of about 1 to 7 and 1 to 17, were much more rapid; consequently, we were able to secure photographs of the faint extension of the outlying corona.

The photographic program included a series of pictures of the partial eclipse to be taken every few minutes (using a metal plate with a small central hole to cut down the light). For totality, we used twelve fast portrait plates, Eastman 40's, in double plate-holders which were backed with lampblack and shellac to prevent halation caused by reflection from the glass side of the plate. For our Finlay Process color photography we used four double-coated special supersensitive Wratten panchromatic plates. Besides filming the total eclipse, Father Swift also photographed the various phases of partial eclipse with his movie camera. Then just before totality he succeeded in catching the elusive shadow-bands as they flickered over a white cloth screen which was nailed up on a frame facing the sun and at an angle of 70° with the ground. Father Kolkmeyer was in charge of a continuously recording photometer for measuring the light intensity of the corona. The design was developed by Father Theodor Wulf, S.J., of Valkenburg, Holland; and the machine was built by Leybold of Cologne. The photographic recorder, which makes use of motion picture films, was built in Washington by the American Instrument Company. The eyes of the photometric instrument are a pair of photoelectric cells, and the heart of it a Wulf electrometer. Full details of its operation will be furnished by Father Kolkmeyer himself in a separate article.

Accessory apparatus included a transit from Weston for accurate position lines, a fine Hammerlund Comet Pro short wave set for time signals, and an excellent chronometer and chronograph loaned by the Coast and Geodetic Survey. In addition, at the request of the Lick Observatory Expedition, we planned to use the Georgetown plane-grating spectrograph mounted on the telescope, for coronal photography in the infra-red, exposure to be made throughout totality.

Mr. Walter Cusick, a radio engineer connected with Father Daley's Research Products Corporation; and Mr. Frank Malcolm Gager, an instructor in the Electrical Engineering Department of Massachusetts Institute of Technology, brought to our eclipse site a formidable battery of Father Daley's radios for measuring the relative radio signal intensity from long before first contact until long after fourth contact. Their tentative report roughly estimated a four-to-one rise in signal strength during totality, with occasional wide unexplained variations and flickerings. The possible effects of magnetic storms on radio tests must be considered, since there were displays of the aurora borealis on the nights of August 28th and 29th.

The National Geographic Society put its men under the direction of Father McNally, with 17 Warren Street as their headquarters, so that the work of Captain Albert W. Stevens and Lieutenant Charles D. McAllister of the U. S. Army Air Corps may properly be mentioned here. They flew in a large army plane at a height of 28,000 feet, and in addition to filming the usual eclipse phenomena, they attempted to photograph the moon's shadow advancing at a rate of 2700 feet per second. Their report appears in the November *National Geographic Magazine*, as well as an illustrated article on the eclipse by Father McNally.

An eclipse expedition necessarily entails a lot of hard work for the participating astronomers, unless the manual part be done by others, as for example in the case of the Naval Observatory Expedition to which a quota of "gobs" was detailed for all rough and heavy work. After you mix concrete all day at 93 in the shade, you do not feel like staying up half the night taking polar adjustment plates and focus plates to regulate the instruments on the stars. Then come the frequent drills to familiarize each one with his part in the program, and every motion is watched and studied to eliminate any wasting of the precious seconds. In explanation of the smooth execution of our program on eclipse day, it may be of interest to note that a total of 76 practice sessions were held beforehand. And the nerve racking experience of the last day is something to remember, especially for the Director who does most of the worrying just as he bears most of the responsibility for success or failure.

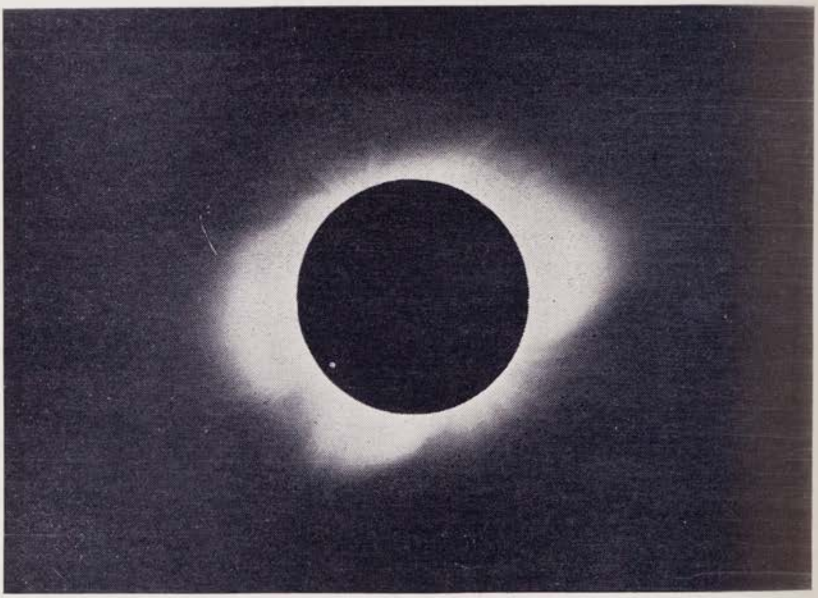
Meanwhile, during all the arduous days of preparation, we were literally besieged with newspaper men, news-service photographers and visitors of all kinds. We made no bid for publicity, in fact, Father McNally purposely chose for our site a backlot on a sidestreet on the edge of the town in order to avoid visitors. But still there were throngs, especially a few days before eclipse time, and so an enclosure was roped off and guarded by the local Boy Scouts on August 31st. The idea of priests being also astronomers was so novel to most people that we actually received more widespread publicity than the Mount Wilson Observatories combined. When Father Stein came, the burden fell on his shoulders, and the Fox Movietone people insisted on two talkies (one for their Italian release) recording conversation between him and Father McNally, with nine Roman-collared Jesuits draped around the telescope for background.

As for the all-important question of weather, it can be said that prospects were discouraging from the start. It was threatening nearly every day, especially in the precise spot (having an azimuth of 71½° and an altitude of 30°) which preliminary computation had indicated as the position of the sun at the zero hour. August 31st was no exception to the rule. The Big Day dawned with the entire sky full of high cirrus clouds, and hour by hour as the sun succeeded in piercing the clouds, they seemed to gather together more and more and float around in fluffy bunches. About noontime we had a typical summer sky, with lazily floating clouds obscuring the sun only occasionally.

In the morning we ran through our last practice sessions, and it was decided that the following order be used for exposure for both the five foot and the two foot camera:

1st plate-holder,	first plate (Finlay Color)	— 3 seconds
2nd plate-holder,	second plate	— ½ second
	third plate	— 1 second
3rd plate-holder,	fourth plate	— 2 seconds
	fifth plate	— 3 seconds
4th plate-holder,	sixth plate	— 4 seconds
	seventh plate	— 5 seconds
5th plate-holder,	eighth plate (Finlay Color)	— 5 seconds

Father McNally had the distinctly unenviable job of emptying and refilling the plate-holders used for the Finlay Color Plates, loading them with new plates and rushing them back to us just in time after the exposure of the third pair of black and white plates. He made it with a second or two to spare during the eclipse. Think what that means. At the count of four, the first Finlay Color Plates were handed in to Father McNally through the window of the shed. He had to rush into the dark room, empty both plate-holders, and then, working in absolute darkness, he had to put in new plates, replace the cardboard backing and reinsert springs which held the backing tight against the plates, lock the hinged plate-holders and have them outside ready for use at the cameras by the count of 75!



G. U. Eclipse Expedition Photo.

An unusually clear photograph of the recent eclipse taken by the Georgetown University Eclipse Expedition under the direction of the Rev. Paul McNally, S.J.

Now for the eclipse. Billowy clouds were gradually creeping towards the sun as we prepared to get an accurate timing of first contact; at 2:19, the instant when grazing contact would have been visible, a dense cloud reached that edge of the sun. The clouds cleared away occasionally, allowing six plates to be exposed for a half second each for phase pictures of the decreasing crescent of the sun, at the following approximate times:

2:45 2:46 2:54 3:01 3:08 3:18

Then came the anxious moments, especially for Doctor McNally, as the two Finlay Process plate-holders along with six double plate-holders had to be loaded, and all in five minutes. The plates stuck miserably in the holders, one of them even breaking in Father McNally's hands. He finally got all four holders loaded for each camera, but the spectrograph could not be loaded in time; for after the first brief exposure of the Finlay plates, the latter had to be taken out and the holders refilled.

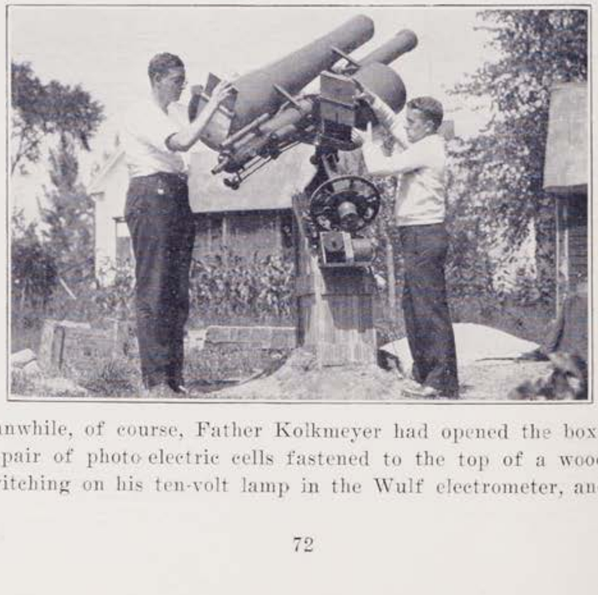
It was already getting dark, wierd crescent-shaped patches of light being cast as images of the sun on a white sheet spread out on the ground under some trees. As late as a minute before totality was due, the whole thing looked hopeless, due to clouds drifting over the sun. With only a few seconds to spare, there occurred a two-way drift of the clouds, and a providential rift in the clouds appeared for not more than two or three minutes. The darkness was not as much as expected, due to reflection from the clouds; but in that ghastly light it was queer and unnatural even before the hush and dimness of totality. New meaning was given to Homer's lines:

> "*The sun has perished out of heaven,*
> *And an evil mist has overspread the world.*"
> Odyssey, Bk. XX, 356-357.

Father Thomas Smith had been calling warning time signals for us to be at our posts. Father Swift had been taking snaps of the sun, but before totality he changed to shadow-band photography. The shadow-bands were clearly perceived by Father Stein as they wavered and danced on the sheet we had arranged to catch them. The writer noticed them clearly as they flickered over the white shirt of Father Thomas Quigley. The latter stood facing Father Barry and myself as we waited for his signal for exposure of the first plate and closing of the shutter again. The shadow-bands were very distinct, pointing toward the north-west at an angle of 45°, and were about an inch in width. They occurred while we were waiting for the unusually persistent Baily's Beads to disappear, but were not noticed at the end of totality. Father Quigley (and all the other men so assigned on different expeditions) had a peculiarly difficult and nervous job,—delaying the first dramatic signal "GO!" until the last Baily's Bead had disappeared, since one lingered for almost four seconds and cut down our precious total of seconds. Again at the end, our last two color plates were spoiled when the sun burst forth in the "diamond ring" stage a few seconds ahead of predicted time—which is a serious social blunder in the court of heaven! Father Smith, who took care of the time element with a steady count of the seconds as they passed, had only counted to ninety-two when the light returned; and we had drilled for ninety-six second totality as a high enough margin of safety.

Days of drilling had made our every motion automatic, and precisely to the second came the click-clicks of various parts of the apparatus as exposures were made and plate-holders removed. Due to the number of men available, the following procedure was possible. Two men helped the two camera loaders. Father Sohon stood on a step-ladder assisting Father O'Connell who himself was standing on a large packing box in order to get near enough to the holder on the two-foot camera. The five-foot camera was loaded by Father Merrick assisted by the writer, who also ran around at appropriate intervals to open one shutter and hold the proper filter over the lens for the color plates. Father Barry used a different filter for the other camera and performed the exposure all at the timed signals of Father Quigley, who semaphored his orders to us in addition to calling out "UP!" "DOWN!" Filters were exchanged on the two cameras for the second set of color plates. Never did ninety seconds seem to pass so fast. Father Quigley saw little of the corona, Father Merrick none, Father McNally a second or so. The rest of us snatched a few seconds' view. The red prominences were remarkable both at the beginning and at the end of totality.

Father Stein made visual observations entirely, and afterwards rapidly sketched the phenomenon. Here are a few sentences from his accompanying description: "One or two minutes before totality it seemed that the observation would be a total failure, but at the beginning of totality there was a break in the clouds. The chromosphere with its prominences was distinctly seen in its red light, and then immediately afterwards appeared the glorious corona in its silvery white light. Thin clouds surrounded the sun; probably they were formed by condensation in consequence of the cooling of the atmosphere by the shadow of the moon. There was a large streamer in the corona at the east side; its length was about one and one-half or twice the diameter of the sun. The corona seemed to be of the wind-vane type, as is the case at the minimum of the sun spots. The duration of totality was about ninety-two seconds, and not ninety-seven seconds as predicted, and the end came rather unexpectedly. Then we saw again the red color of the chromosphere and prominences, and what is commonly called the diamond ring. . ."



Meanwhile, of course, Father Kolkmeyer had opened the box containing his pair of photo-electric cells fastened to the top of a wooden pole, after switching on his ten-volt lamp in the Wulf electrometer, and setting his moving picture recorder in motion. In preliminary tests and developments of the film, he had gotten a very sensitive recording of even slight changes in light intensity, together with a very delicate periodic variation that seemed to be in the neighborhood of the 60-cycle alternation. The time in seconds, with a break at fifty-nine, was clearly impressed on the film record by electrical connections from the chronometer.

It is too soon to evaluate the scientific results, but it is already clear that the objectives of our program have been successfully attained. Twelve black and white plates turned out excellently, and show a wealth of detail in both the inner and the outer corona. Father Stein thought that several of them gave more details at once than any picture he had ever seen of the coronal phenomena. The long equatorial wings extending for upwards of a million and a half miles, and short, often curved, plumelike polar streamers characteristic of the sunspot minimum were very marked in our plates, though it is difficult to reproduce the fainter outer extensions unless care is taken in reprinting. The plates show up well in the November *National Geographic Magazine*. The tedious work of measuring the plates has not as yet been attempted. Two of the color plates were ruined by the untimely reentrance of the sun upon the scene. The other two showed some indication of color upon development, but the long process of getting the positives has not been completed. Father Kolkmeyer's photometric film record was developed but the measurable results in the form of a varying light track are disappointingly meager. Father Swift's films turned out excellently. Besides many shots of interesting places in Fryeburg, there are beautiful glimpses of the surrounding mountains. He has a fine record of one of our dress rehearsals at the astographic cameras, and then the real show of August 31st is completely filmed. An entertaining quarter of an hour will be had by those who see these movies.

The Georgetown Expedition for the observation of the Eclipse of August 31st, 1932, was a success only because a thousand possible chances of failure were obviated by careful planning and generous co-operation on the part of all members; and because Providence saw to it that for us at least the eclipse was not eclipsed by clouds. If American Jesuits now living intend to engage in this big-game hunting in years to come, they will have to travel to various places in accordance with our vocation; for conditions are said to be rather unfavorable for the next American eclipses, which are due on July 20, 1963, again in New England but this time a little further south; and on March 7, 1970, in Florida. And really ,the next total eclipses of the sun which can be viewed from the continent of the United States under conditions that promise scientific success, are those of August 21, 2017 and April 8, 2024. Nor is it impossible that long before the year 2017, astronomers will have solved all the problems connected with solar eclipses. Or again they may no longer need an eclipse to study chromosphere and coròna, just as they now no longer need an eclipse for the study of the prominences.

But in any case, here are some brief practical hints for future astronomically-alert expeditions:

Instead of taking the telescope tube along, it would be preferable to construct a box camera of the required length. The focusing arrangement of the objectives would be sufficient for a refractor.

A magazine for all the plates should be devised, so as to allow more rapid loading and reloading of the cameras.

Plenty of extra plate-holders should be brought, especially for color work with hypersensitive plates. The plate-holders should be absolutely light-tight. It might be well beforehand to load each plate-holder and expose each side to the light of the sun; development of the plates would detect any leaks present. For Finlay Process photography, the supersensitive plates should be backed with some absorbing material, even though the makers of the plates claim that the double coating of the plates is sufficient to prevent halation.

A short exposure should be scheduled for the last plate on the program, in case of an unexpected reappearance of the sun before predicted emergence. A delay of one-tenth of a second in ending that exposure may ruin the last plate, and so it would be better to allow a sudden return of the sun's brightness to spoil as little as possible.

Adjustment of the polar axis may be conveniently accomplished by photographing a bright star group, first following for a few minutes by use of the driving clock, supplemented visually by bisecting a star the guiding cross-hairs; and then allowing the stars to trail. When the plate is developed, an analysis of the relative direction of the images and trails and comparison with the orientation of the plate and star field, will show whether or not the polar axis is exactly in the meridian and whether it is too low or too high at the north end. The latter defect may be remedied by inserting wedges between the base of the telescope and the top of the pier.

A comparison scale of magnitudes should be secured on each plate before they are developed, by exposing them to one of the many varieties of sensitometer known to astronomers. Uniform development results when development is stopped immediately after the appearance of the circle or square of smallest magnitude.

The plates should be given to experts for developing. For instance, the superb new photographic laboratories of the National Geographic Society were very courteously put at our disposal, and development was made under control conditions that are ideal.

All in all, Georgetown's adventure in solar eclipse research was a memorable experience, particularly remarkable for the unique amount of attention it focused on the work that Catholics and especially Jesuits are doing for the advancement of science.

BIOLOGY

THE STAINING OF BLOOD

LLOYD F. SMITH, S. J.

To make blood smears, rapidly, uniformly, and with complete separation of each corpuscle, and to stain them so that the various types of leuconcytes stand out prominently, may have been found difficult at times. The following method seems to have overcome these difficulties. Its general outline may be found in "Approved Laboratory Technique", p. 78. For the benefit of any who may not have seen the book, the method is here described with the addition of several minor points which, from personal experience, appear to be of the utmost importance in actual practise. If the process, extremely simple in itself, is described apparently in excessive detail, this may be charged to an effort to include every essential point, in the hope that any one wishing to try the method may be spared the exasperation I have so often experienced in my futile endeavors to follow most laboratory directions in microscopical technique, from which, as if by an unviolable law, fundamental details are habitually omitted. To dream that this defect has been avoided in the present paper is probably sheer optimism, but the attempt may seem to some to be its own justification.

A. *Obtaining the Blood.*

Sterlize the finger with 70% alcohol and puncture it with a spring blood lancet. The advantages of the spring lancet are so many and obvious that, once used, it will become a permanent fixture for blood work. If the blood flows slowly, its flow may be increased by washing the hands in hot water and then making the puncture, or by 'milking' the finger after the puncture. To 'milk' the left forefinger, encircle it at the base with the thumb and forefinger of the right hand. Then push the right hand towards the tip of the left forefinger, exerting a moderate, firm pressure. Avoid pressing the cut finger nearer the cut than one inch. Squeezing the finger near the cut, forces out a fluid which is chiefly serum, and this will dilute the blood (an important thing to avoid in making blood counts) and will make the blood clot too soon. Wipe off the first drop of blood and begin making smears with the second drop.

B. *Making the Smear.*

Have prepared the number of slides desired, cleaned preferably by letting them stand for a few minutes in 70% alcohol. Five minutes suffice. Wipe the slides dry with cheese cloth. Place a clean slide on the table on a piece of clean paper. Hold the edges of a second clean slide between the thumb and forefinger of the right hand. With the slide horizontal the fingers should be at the right end of the slide. Touch the lower surface of the left end of this second slide to the drop of blood. Quickly bring the second slide in contact with the upper surface of the first slide at its right end, inclining the second slide with reference to the first at an angle of approximately 5 to 8 degrees. The exact angle is important and it will help to estimate it precisely beforehand by means of a protractor. The drop of blood will spread across the end of the second slide where it comes in contact with the first. As soon as this occurs move the second slide across the first from right to left.

The tips of all the fingers should rest on the table in order to keep the slide steady and at the right angle during its movement. Put the first slide aside to dry. Place the second slide in the position just occupied by the first, the side with the small amount of blood already on it being next to the table. Take a third clean slide and with it make a smear on the second and so on. With a very little practise from 10 to 20 smears per minute can easily be made by this method.

C. *Staining the Smear.* (Feemster's Modification of Wright's Method) (3).

Solution No. 1. Dissolve 0.3 gm. of Wright's stain in 100 cc. absolute methyl alcohol. Wright's stain, put up in capsules of 0.1 gm. each, prepared by the National Aniline and Chemical Co., N. Y., is very satisfactory. Let stand 1 or 2 days with occasional shaking. Filter and add 20 cc. absolute methyl alcohol.

Solution No. 2. Dissolve 0.3 gm. of Wright's stan in 90 cc. of 95% ethyl alcohol and 10 cc. distilled water. Let stand 1 or 2 days with occasional shaking. Filter.

It will be found convenient to rest the slide on a large cork during the following operations. By means of an eye dropper, cover the dried blood smear with Solution No. 1. As soon as the whole slide is covered, pick it up, and drain it off into the sink, not back into the original solution. Place the slide back on its cork and allow to stand in the horizontal position until the slide turns red. Time about 40 seconds. With an eye dropper add enough distilled water to cover the slide. Use water freshly distilled, or at least not more than 1 or 2 days old. (4) Let stand 1 minute. Pour off the distilled water into the sink. Pour Solution No. 2 into a flat dish, such as a petri dish. Wash the slide in Solution No. 2 until most of the red precipitate disappears, moving the slide up and down in the solution by means of a pair of forceps. Time about 20 seconds. Wash slide in a dish of freshly distilled water until the water flows evenly from the slide. Wipe off the bottom of the slide and wipe the top at either end with a clean cloth. Blot the smear gently with a piece of clean filter paper. The dry smear should have a uniform, delicate pink color.

D. *Examination.*

Examine the smear under oil immersion. For oil immersion, methyl benzoate is suggested instead of cedar oil. It will prove just as satisfactory for most work and will evaporate off the slide and lens, thus dispensing with the use of xylol for the usual cleaning off of the immersion oil.

The slides made in this manner are the best we have seen, for excellence of the smear itself and for brilliance of staining. If a few slides, made in accordance with these directions, are desired for examination or comparison with other methods, they will be promptly supplied.

References—

1. Animal Micrology, Guyer,—Published by Chicago Univ. Press.
2. Microtomist's Vade Mecum, Lee,—Published by Blakiston, Phila.
3. Approved Laboratory Technique, Kolmer and Boerner,—Published by Appleton and Co., N. Y.
4. Microscopical Technique, McClung,—Published by Hoeber, N. Y.
5. Biological Stains, Conn,—Published by Humphrey, Geneva, N. Y.

A NEW WORK ON CANCER

LLOYD F. SMITH, S.J.

It has long been accepted, almost as a biological truism, that all really important advances, all the revolutionary ideas that have swept away outworn tradition and blazed a trail for future progress have had three characteristics. They are essentially simple. They run counter to the preconceived ideas of the 'latest and most modern biological thought, and are, therefore, denounced as impossible. They are the results of a private individual's hobby, amid the complexities of his other duties, at a time in life when he has not the support of wealthy institutions, when, in short, to the eyes of a professional research worker in our large foundations, he is still an amateur. The important contributions of Mendel, Koch, Pasteur, Ross, Bruce and a host of others may be taken as illustrative of this principle. That their results may be rivalled or excelled by the work to be described, it is, of course, premature to prophesy. But it has all the distinctive characteristics of its fore-runners, and to it, as to the others, the impartial judgment of time will assign the true value.

Enquiring one day last Summer about a friend, the father of a Jesuit, who, at last report, was dying of cancer, I was amazed to learn that he was in the best health he had had for years. Some two weeks later I was fortunate enough to meet the one responsible for the 'miracle', Dr. Arthur P. Keegan of Philadelphia. And as his work has not yet been published, the outlines of its general principles may prove of interest.

A. *An Embryonic Theory of Cancer.*

In man, as in other forms reproducing sexually, a sperm fuses with an egg to form the single embryonic cell. This cell divides repeatedly, forming the morula, blastula, gastrula, and then the three germ layers from which all the organs are derived. In this rapid cell division, it is obvious that three possibilities present themselves. For any one of the germ layers there might be produced—

a) One or more cells too many,

b) One or more cells too few,

c) Just the right number of cells.

Of the many theories of cancer, that commonly associated with the name of Cahnheim suggests that, in the first possibility, these few extra embryonic cells might lie dormant among the other maturing tissues, retaining their capacity for riotous growth, always affording what a true Scholastic philosopher would delight to call 'cancer in potentia'. Later, Cohnheim thought, some stimulus might start these cells dividing again and thus produce the typical malignant tumors, popularly known as cancers. Strictly speaking, the term cancer is restricted to the malignant epithelial tumors or carcinomata. A malignant tumor of connective tissue is called a sarcoma.

The second possibility enumerated should result in a complete or partial absence of normal parts, such as cleft palate, hare-lip, absence of the lobe on the ear, etc. According to the theory, such a person could not develop cancer and in his wide experience Dr. Keegan has never come in contact with, or heard of such a case. The third possibility should produce a perfectly normal individual, and actually we know that the majority of mankind give no indication of having cancer.

B. *The Blood.*

According to the embryonic theory, the cancer cells are present in the body long before birth. But for some reason or other they do not ordinarily produce their effects for many years, when the individual is advanced in years. Now that which comes in most intimate contact with every cell in the body is the blood, and its close relative, the lymph. One day about four years ago, after seventeen years of meditation on the subject, it suddenly occurred to Dr. Keegan that there might be a substance in the blood which normally holds the cancer cells in check, and that later in life this substance might disappear or undergo change, allowing the cancer cells to start their invasion. Or certain parts of the body might secrete into the blood a new substance, which would give the cancer cells the stimulus necessary to initiate their development. Under either alternative it is supposed that if the body contains cancer cells (i. e. extra, embryonic cells), and if the blood chemistry changes, even slightly, then the cancer cells may begin their growth. Were this true, then all that would be required would be to change the blood chemistry and the cancer cells might possibly be put back under control or become mature. The second result would be as good as the first, for mature cells do not normally divide.

It has long been known that hnman blood can be grouped into four types, depending on the agglutination of the red corpuscles. Clearly there must be a chemical difference between these types of blood, so that, if a patient with one type of blood were to have blood of another type injected, there should be a chemical change effected in the blood of the patient in question. What would happen if a cancer patient, having blood of type 2, (said to be true of 67.5% of all cases), were to be injected with blood of types 1, 3 or 4? Any doctor will tell you at once, laughing at your simplicity. If types 1 or 3 were injected the red blood cells of the patient having blood of type 2 would undergo agglutination, then haemolysis. The haemoglobin would be precipitated in the tubules of the kidney, obstructing their lumen. Almost complete anuria would develop and in a few days, after increasing lethargy, the patient would pass into a coma and die. But the curious fact is that cancer patient don't.

C. *The Treatment.*

When a cancer patient comes to Dr. Keegan, the first and most important consideration is the diagnosis. A biopsy is performed and a piece of the suspected tissue removed. From the stained slide a competent pathologist makes the diagnosis (Dr. J. Howard Smith in the written reports I have read), and, if the diagnosis is of cancer, Dr. Keegan proceeds. Next the type of the cancer patient's blood is determined. Then blood of any other type is injected at stated intervals in determined amounts. Although there is a special technique which has been developed for the work, its essence is simply as stated.

D. *The Results.*

After the treatment is under way, there is a sharp rise in temperature, followed by a gradual fall. The pain leaves almost at once, and the odor, so marked in many external cancers, disappears. The tumor then gradually softens, diminishes in size and ultimately seems to have vanished. The work has not been going on long enough at the present time to state that the tumor never reappears. In fact, to state that any one had been completely cured of cancer, it would be necessary to have the patient live for a reasonably long period after treatment, and then, at a careful autopsy, be proven to have been entirely free of cancer. For this reason Dr. Keegan does not call his treatment a cure, but a control of cancer.

One day when he was on his rounds of the hospital (St. Agnes'), to see his cancer patients, I accompanied Dr. Keegan. In several instances the tumors, being internal, could not be seen, but in two cases even a novice in diagnosis might risk a guess. One case was that of an elerdly lady, who had an epithelioma in the region of the ear. A photograph, made before treatment began, showed a large, black, irregular mass, about as large as a medium sized potato. When I saw her, the tumor had subsided to about the normal level of the skin, which could be seen to be gradually returning to normal around the edges and growing centripetally. Dr. Keegan informs me that she has since died, but of a heart attack. Another case was that of an old man with a melanotic carcinoma of the foot. This patient told me that before treatment a considerable portion of the sole of the foot was affected, but at the time this portion appeared practically healed, while the remainder on the side of the foot seemed definitely healing. Two large lymph nodes, to which metastasis had evidently taken place, were still palpable under the skin, higher up the leg, but the patient said they were softening up and they certainly seemed to be. On the same leg could be seen a scar, marking the place where a lymph node had been cut out for the biopsy. At the present time this patient is reported as apparently free from cancer.

To date Dr. Keegan has treated about 112 cases, practically all of which were far advanced and had come under his care when all other hope of cure had gone. In many cases, after about six weeks time, the patients walked out of the hospital, as far as could be determined, cured. Some who died under his care were far advanced in the disease upon admission, and, if we may judge from the others, had they come under his treatment earlier, they might have been saved.

E. *The Future.*

The work is expanding. Seven young doctors have taken up the work under Dr. Keegan, studying his patients, checking the results, perfecting the technique, striving to advance the method. For, although so much has been done, the work is still in its infancy. By the time his 200th case has been recorded and the patient dismissed, Dr. Keegan expects to begin to publish, most probably next year. Already rumors are circulating, doctors are becoming curious, from different parts of the country cancer specialists are coming to Philadelphia to observe, to question, to weigh the evidence. A few laugh, some argue heatedly that it is impossible, many hope, most merely await developments. What the future may hold for us, who can tell? Some day shall a doctor lightly tell a patient his diagnosis of cancer, knowing that the nameless terror of the word has vanished? Shall there come a time when cancer is as rare in civilized society as yellow fever, malaria, and so many dread scourges of the past? If Dr. Keegan's theory is correct, then, in spite of unbelief, ridicule, and opposition, that day is not far distant.

F. *Conclusion.*

One hundred and twelve patients who were proved beyond question to have cancer have been treated. In many cases, without surgery, without radium, x-rays, and the other usual methods, but simply by injecting another type of blood, the tumors have apparently disappeared, the pain ceased and the patients returned to a normal way of living. Dr. Keegan has to date worked only on malignant epithelial tumors, or true cancers, but he believes that the method is applicable to the others. His working theory is that the cancer cell is not in itself malignant. It is a misplaced, embryonic cell, which, due to a change in the blood, grows, producing a protein which is malignant. He calls his treatment not a cure, but a 'control' of cancer.

NOTE—Although permission to publish this paper in the *Jesuit Science Bulletin* was obtained from Dr. Keegan, any errors which may be included must be attributed to the writer.

CHEMISTRY

MICRO-CHEMISTRY

Rev. Richard B. Schmitt, S.J.

Micro-methods in the chemical laboratory are finding more applications every year. These micro-methods signify not only the chemical reactions observed by the use of the microscope, but include all the methods in which minute quantities are used. Many of these are now well established and have proven their reliability in many fields of chemistry, both in education and industry. The advantages of micro-methods have shown that there is extreme accuracy and at the same time an economy of time, space and material. The Universities in the eastern part of the United States that teach micro-chemistry include: New York University, Cornell University, University of Pittsburgh, Fordham University, University of Alabama, University of Illinois, etc. Many of the Universities in Europe have practised these methods for several years.

At the present time successful methods are established in Inorganic Chemistry, Qualitative Analysis, Quantitative Organic Analysis and Physical Chemistry. Of these, two are still in the formative period and will no doubt be vastly improved. Quantitative Organic Analysis is a well seasoned course in Organic Chemistry. The micro-methods of the late Dr. Pregl and his co-workers have given us methods that are very successful and give excellent results.

Dr. Francis O. Rice, Professor of Chemistry at Johns Hopkins University pursued his research in "Free Radicals in Organic Chemistry," at the University of Heidelberg, Germany, for the past five months; he made the observation that his progress would nave suffered much delay except for the micro-methods in Organic Chemistry.

In the field of Inorganic Chemistry there are many isolated facts known about many compounds. However, they are not fully organized in a systematic way. Most of the facts known may be found in Dr. Emich's publications and in the two volumes of "Chemical Microscopy" by Chamot and Mason.

The University of Pittsburgh has regular courses in General Chemistry and Qualitative Analysis. A complete description of their work will be found in *The Journal of Chemical Education* for September and October, 1932.

The late Professor John A. Mandel of New York University and Bellevue Hospital Medical College, was one of the first in America to realize the importance of micro-chemical methods for medical diagnosis. His work was principally done in Bio-chemistry, Physiological and Pathological Chemistry. Dr. Mandel and H. Steudel rendered a valuable contribution to medicine by perfecting a complete and concise procedure for the quantitative determination of fourteen constituents in a sample of from seven to ten cc. of blood.

Prof. Joseph B. Niederl was an assistant to Prof. Mandel for several years; and in 1925 a co-worker of Dr. Pregl in the University of Graz. Prof. Niederl is now Director of Micro-Chemical Laboratory at New York University.

Dr. A. A. Benedetti-Pichler, a co-worker of Prof. Emich at Graz, is in charge of the micro-methods in Inorganic Chemistry. Dr. Niederl and Dr. Pichler gave a lecture and demonstration in "Micro Chemistry" at Loyola College on November 22nd.

The Chemistry Department of Loyola College has installed a Carl Zeiss polarizing microscope and a Wm. H. F. Kuhlman Micro Balance and other equipment and apparatus.

Just recently Mr. Frank Schneider has established an agency for all the aparatus made by Paul Haack & Co., of Vienna, Austria, for micro analysis. The address: Microchemical Service, 30 Van Zandt Ave., Douglaston, Long Island, New York.

Special imported chemicals may be purchased from Akatos, Inc., 114-118 Liberty St., New York City.

BOOKS FOR MICRO-CHEMISTRY

Micro-Chemical Laboratory Manual, Second Edition, 1932,
Friederich Emich. John Wiley & Sons.

Quantitative Organic Analysis—Second Edition, 1930,
Fritz Pregl. P. Blakiston's Son & Co., Phila., Pa.

Handbook of Chemical Microscopy, Vol. I, 1930,
Chamot & Mason. John Wiley & Sons.

Handbook of Chemical Microscopy, Vol. II, 1931,
Chamot & Mason. John Wiley & Sons.

Industrial Microscopy, 1929,
L. C. Lindsley. Wm. Byrd Press, Richmond, Va.

Practical Chemistry by Micro-Methods, 1925,
Egerton C. Grey. W. Heffer & Sons, Cambridge, Eng.

Lehrbuch der Mikrochemie, 1926,
Friederich Emich. Bergman, Munich, Germany.

Mikrochemisches Praktikum, 1931,
Friederich Emich. Bergman, Munich, Germany.

Qualitative Mikrochemische Methoden, 1929,
Mayrhofer, Urban & Schwarzenberg, Berlin, Germany.

Monthly Journal: "Mikrochemie."
Published by: Emil Haim, Leipzig, Germany.

RESEARCH AT FORDHAM UNIVERSITY

Rev. Francis W. Power, S.J.

The chemical research at Fordham is being carried on as in the past along the lines of Physiological Chemistry and Organic Chemistry; most of the problems in the latter branch being related to Physiological Chemistry.

Among the problems under consideration, at present, are the following: A—Under Dr. Sherwin.

1. Investigation of formation of p-bromphenylmercapturic acid which is the detoxication product of brombenzene in the animal body. This problem has received the attention of several investigators including those at Fordham but there are a good many points as yet unsettled and upon which the various authorities differ so the problem is being investigated along those particular lines and will be carried on further with relation to the use of glutathione as an intermediary detoxicating agent.

2. The study of the behavior of the three amino phenols in the animal body. This problem is practically completed as far as it can be done and the results are not entirely satisfactory on account of the formation of complex black substances which very likely are similar to aniline black and which are, therefore, very difficult to obtain pure.

3. The study of the distribution of phenylacetic acid ingested by the human subject between its two detoxicating agents, glutamine and glycuronic acid. This problem also has occupied the attention of Fordham chemists for many years past but chiefly from the standpoint of the glutamine conjugate. Lately, however, in common with certain other investigators, we have become interested in the amount of phenylacetic acid detoxicated through glycuronic acid. The problem has been reported on at two meetings of the A. C. S. and considerable data have been accumulated which have not yet been published but the whole problem is still unsettled on account of the seeming impossibility of getting a clean cut specific separation for the glutamine conjugate and the inadequacy of the various methods for determining glycuronic acid, some being too sensitive and others not sensitive enough.

Allied to these problems as being in the Physiological lines are the following: B—Under Dr. Cerecedo.

4. The study of the properties of Vitamin B_1. By using various methods of extraction and concentration of solutions obtained from yeast and from rice polishings, several investigators have obtained a concentrate of the anti-neuritic vitamin in a very high state of purity, judging by its effect on experimental animals placed on a deficiency diet. However, the ultimate analyses and the ultra violet absorption spectra of the final concentrates obtained by these different investigators are in very poor agreement. Using a method developed by himself and Dr. Freudenberg, of the University of California, Dr. Leopold R. Cerecedo is working on the isolation of Vitamin B_1 from rice polishings, the method being largely based

upon that of Jansen and Donath. Mice are used as experimental animals. At least two modifications introduced by Dr. Cerecedo have proved, in preliminary experiments, to be very useful and we have several reasons to believe that he will eventually obtain a purer vitamin concentrate than has been obtained hitherto, if not the actual substance itself.

5. Although the effect of diet on growth has been extensively studied in the past, most of the work has been carried out by means of growth experiments on small experimental animals such as mice and rats, the effect of the diet being judged largely, if not altogether, by the increase in weight of the animals. Another Fordham problem is the study of the effect of diet on growth judged not only by growth experiments but by obtaining the complete metabolic history of the animal. In this particular case puppies will be used as subjects. The studies will be begun shortly after the puppies are weaned and the partition of sulfur and nitrogen, as well as the increase in weight of the animals, will be followed through the entire period of growth.

6. Another problem on sulfur metabolism is being carried out with dogs as experimental animals investigating the role of sulfur in any one of its various forms as a detoxicating agent, particular attention being paid to the conjugation of isobarbituric acid. This substance has been found to behave in the human organism as it does in the dog. This problem involves the preparation of the sulphuric acid ester of isobarbituric acid which is similar in principle to previous attempts made in this laboratory to prepare and study the behavior of indican in the body, a substance allied to the compound desired in this case in that it is the sulphuric acid ester of indoxyl.

7. Finally, one man is investigating the extraction of a pure concentrate of Vitamin B_2 from brewers' yeast using about the same methods as for B_1.

8. Another is studying the relative ease of oxidation and the intermediary products of various pyrimidine derivatives in vitro as compared with the similar oxidations in the animal body.

THE NEW CHEMISTRY LIBRARY AT BOSTON COLLEGE

Rev. Joseph J. Sullivan, S. J.

Year by year, the growth of the library of the Chemistry Department has assumed more and more the proportions of a real problem. Heads of the department have always kept in mind the acquisition of important books and journal articles which would be useful contributions to the Chemistry Library.

At present, there are on our shelves some three thousand volumes which are being referred to continually by the chemistry staff, by the students and by others who are interested in the subject. Recently, Room 306, which is off the Organic Laboratory, has been made available and most of the books which are in steady demand have found a place there. This room is well lighted, airy, and has a long study table for those who wish to work there in quiet and seclusion. The books are kept in closed bookcases to protect them as far as possible from the harmful atmosphere of the Chemistry Laboratory.

The equipment of the library is worth mentioning. There are the usual reference journals and publications of the various Scientific Societies, dating from 1876; a complete set of the Berichte der Deuschen Chemischen Gesellschaft; a complete set of the Journal of Chemical Education; the Bureau of Standards Journal of Research, the British Chemical Journal, Journal of Physical Chemistry, and Seitschrift fur Physikalische Chemie. Current publications received in the library include, besides the above, Transactions of the Faraday Society, Transactions of the Electrochemical Society, the Chemist, Science, Nature, Government pamphlets, Monographs, Dissertations, and other publications of interest to the student of Chemistry.

Since, however, it is impossible to read all the Journal articles which are published in the literature, the library makes an attempt to keep up to date with the various abstracts of these articles which are published by the different Chemical Societies. There is, therefore, a complete set of the Abstracts published semi-monthly by the American Chemical Societies; a complete set of the Abstracts of the British Chemical Society, and a complete set of the Centralblatt, published by the German Chemical Society. The foregoing are the accepted sources for immediate reference.

In addition, the library contains various reviews of recent chemical literature, such as Chemical Reviews, the Annual Survey of American Chemistry, and the Annual Reports on the Progress of Chemistry, prepared by the Chemical Society, London. Compendiums containing information relative to the various branches of chemistry, taught at Boston College, either in the undergraduate or graduate departments are also found on its shelves. There are Beilstein, Richter, and Cohen in Organic Chemistry; Gemelinkraut, Mellor, Roscoe and Schorlemmer in Inorganic Chemistry. For Colloid Chemistry, there is the Colloid Symposium. And for Analytical Chemistry, Physical Chemistry, Electro-Chemistry, Atomic Structure, Thermodynamics, etc., are found the standard treatises which have been prepared to date.

The library also is rich in compilations of tables and accurate scientific data. For example, there are the International Critical Tables, the Chemische Tabellen of Landolt-Bornstein, and all of the common handbooks.

Technological chemistry has not been neglected. Besides a complete set of the Journal of Industrial and Engineering Chemistry and of the Journal of Chemical and Metallogical Engineering, there are monographs and sets of volumes on petroleum, fats and waxes, the volatile oils, resins and plastics, ceremics, textiles, metallurgy, paints and varnishes, and other topics of interest to the chemist in modern industry.

Neither have we overlooked the subject of Biological Chemistry which deals with the important relations between chemistry and life. Numerous books and treatises on various aspects of this engrossing subject are available.

Chemical Biography has always been an inspiration to the student of chemistry. The accomplishments of the great leaders in Science are an impetus to him today. Several score of books, monographs, and special brochures treating of the human side of chemistry and chemical history have been acquired and are at the students' call. The course in Chemical Bibliography which is obligatory to all graduates and which is represented by several important tomes in the library, acquaint the student with the treasures to be found in chemical literature and teach him how to dig and mine for them.

All books and pamphlets are catalogued according to the system used in the Library of Congress, Washington, D. C. Duplicate cards are kept in the files of the main library in the Library Building.

A copy of our message to the students of Chemistry may be of interest. It follows:

BOSTON COLLEGE

THE CHEMISTRY LIBRARY

To The Student of Chemistry:

This is an invitation to inspect and make use of the numerous books and periodicals on the shelves of the Chemistry Library. You will find there a choice of the best books available today on the subject of Chemistry. There you will become acquainted with the great figures which have dominated the field of Chemistry, and have contributed to the world's store of knowledge, and its quest for advancement. There you will learn the story of what Chemistry has done for mankind.

If you are interested in tales of great accomplishment, there you will find them written with a wizard's hand. If you are interested in mysteries solved, there you will find them on every page.

We urge you to read and to study the books in the Chemistry Library. And we ask you on your part kindly to keep in mind the following rules:

1st. Books are to be left on the shelves for consultation and reference during the day.

2nd. No book is to be used in a laboratory. The reason is obvious, as laboratory surroundings are certainly not conducive to the long life of paper or binding.

3rd. Books may be taken out between 1:00 and 2:00—4:00 and 4:30 P. M. and may be kept out overnight or over a holiday period.

4th. All books are to be returned before 9:30 the succeeding class day.

"Legere et non intellegere est neglegere."

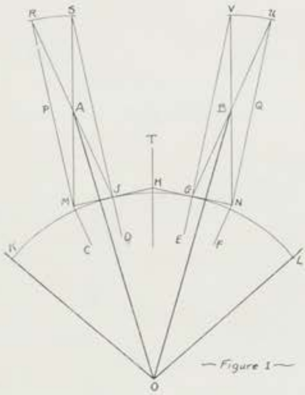
MATHEMATICS

CRITICISM OF A RECENT METHOD FOR "TRISECTING" AN ANGLE

Rev. Frederick W. Sohon, S.J.

The following method of trisecting an angle was proposed by Julius J. Gliebe, O. F. M., of St. Boniface Franciscan Friary.

Construction. (See Figure 1).



— Figure 1 —

Let KOL be the given angle.

With O as center and OK as radius draw arc KL.

Draw: OT bisecting ∠KOL.
OC " ∠KOT
OF " ∠TOL
OD " ∠COT intersecting arc KL in J.
OE " ∠TOF " " " " G.

Draw two tangents to the arc KJGL,
one at J intersecting OC in M
one at G " OF " N

Draw MP parallel to ODJ
NQ " " OEG

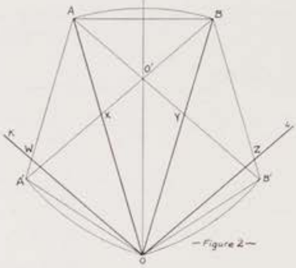
With M as center and OM as radius draw arc cutting MP in R, cutting ODJ in S.

With N as center and ON=OM as radius draw arc cutting OEG in V, cutting NQ in U.

Find A at intersection of RJ and MS, and draw OA=trisector.

Find B at intersection of GU and VN, and draw OB=trisector. The construction thus described is the essential or fundamental construction as distinguished from the supplementary or auxiliary constructions to be introduced presently for the purpose of proof. Proof.

N. B. Since the essential construction lines are not referred to in the proof, a new figure has been drawn in which all the construction lines just described are omitted. See figure 2.



—Figure 2—

Supplementary Constructions.

Through A draw	AY	parallel	to KO	intersecting	OB	in Y
	AW	"	" OB	"	KO	" W
Through B draw	BX	"	" OL	"	AO	" X
	BZ	"	" AO	"	OL	" Z

With OA=OB as radius

and with O as center draw arc AB			
" " B " " " " OA′	intersecting	AW	in A′,
and " A " " " " OB′	"	BZ	in B′

Draw chords AB, OA′ and OB′.

Argument.

The three isosceles triangles OAB, OA′B and OAB′ are readily proved congruent. From this it follows that $\angle AOB = \angle A'BO = \angle OAB'$.

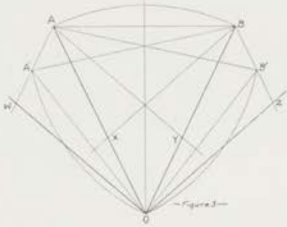
Triangles OBX and OAY would appear to be isosceles, and if this be conceded the trisection is proved since $\angle OBX = \angle BOL$, $\angle KOA = \angle OAY$.

(The argument as given by the author is much more complicated than this, but the rest of the presentation is of less interest).

Criticism of proof.

There is no explicit connection between the essential construction and the proof. The properties of the lines OA and OB must depend on the construction, for these lines differ from other lines through O only in the fact that they are the result of the proposed construction. Hence any property which the lines have that is not shared by other lines through O must be deduced from the construction itself. There must, therefore, be an implicit connection between the construction and the proof.

It may be supposed that the implicit connection will take the form of some concealed premise. To find the concealed premise, we assume two points A and B (Figure 3) that are not the result of the construction, and we attempt to apply the proof to them. A comparison of figures 2 and 3 shows at once the concealed premise.



—Figure 3—

In figure 2 BX passes through A′
BY " " B′

In figure 3 this is not true, and consequently A′BO is not equal to OBX.

Now manifestly there do exist among the lines through O trisectors of the angle KOL, and if these were used instead of OA and OB, BX would pass through A′ and BY would pass through B′. But no attempt has been made to show that the proposed construction supplies the missing premise.

We need not go any further because we knew a priori that the proof must be faulty, and having found a concealed premise that was tacitly assumed without proof, the lacuna has been found.

Trigonometric analysis.

Since a purely deductive process involving only plane geometry does not immediately suggest itself, a trigonometric analysis of the construction is probably most direct and expeditious. This is legitimate as a negative norm, although the problem if solved must be solved by plane geometry. The reference is to figure I.

Let OK = R

Let $\angle$ IOG = $\angle$GON = x

The co-ordinates of the point G are

abscissa = G_x = R sin x

ordinate = G_y = R cos x

The origin being at O, and OT being the Y axis.

Since ON=NV and GN is perpendicular to OEGV
OG=GV=R
so that the co-ordinates of the point V are

$$\left.\begin{aligned} V_x &= 2\,R \sin x \\ V_y &= 2\,R \cos x \end{aligned}\right\}$$

The lengths of the lines GN and NV=NU are

$$GN = R \tan x$$
$$NV = NU = ON = R \sec x$$

Then since GN is perpendicular to GV, the co-ordinates of N are

$$\left.\begin{aligned} N_x &= G_x + GN \cos x = 2\,R \sin x \\ N_y &= G_y - GN \sin x = R\,(\cos x - \sin^2 x \sec x) \end{aligned}\right\}$$

Similarly $$\left.\begin{aligned} U_x &= N_x + NU \sin x = R\,(2 \sin x + \tan x) \\ U_y &= N_y + NU \cos x = R\,(1 + \cos x - \sin^2 x \sec x) \end{aligned}\right\}$$

For the equation of the line VN, we have

$$x = 2\,R \sin x$$

and the abscissa of the point B is

$$B_x = 2\,R \sin x$$

The ordinate of the point B can be obtained from

$$By = Gy + \frac{Uy - Gy}{Ux - Gx}(Bx - Gx)$$
$$= R\left[\cos x + \frac{(1 - \sin^2 x \sec x) \sin x}{\sin x + \tan x}\right]$$
$$= R\,\frac{\sin x \cos^2 x + 2 \sin x \cos x - \sin^3 x}{\sin x \cos x + \sin x}$$

Finally

$$\tan BOT = \frac{Bx}{By} = \frac{2 \sin x \cos x + 2 \sin x}{\cos^2 x - \sin^2 x + 2 \cos x}$$
$$= \frac{\sin 2\,x + 2 \sin x}{\cos 2\,x + 2 \cos x}$$

If the problem is solved $\angle$ BOT should be $\frac{4x}{3}$

If we substitute in this formula, we find that for $\angle$KOL = 48° the position of OB deviates from the true trisector by 3″, while for KOL = 160°, a deviation of 110″ is obtained, the angle BOT being too small in every case.

Thus not only is the construction not proved, but it really does not determine the trisector. The small angle of deviation between OB and the true trisector explains the fallacy in the proof was overlooked.

Let $\angle$KOL = 48°
x = 6°
$\angle$BOT ought to be 8°

sin 12° =	.207912	cos 12° =	.978148
2 sin 6° =	.209056	2 cos 6° =	1.989044
N =	.416968	D =	2.967192

log N = 9.620103
colog D = 9.527654

log tan BOT = 9.147757
$\angle$BOT = 7°59′57″
discrepancy = 3″

Let $\angle$KOL = 160°
x = 20°
$\angle$BOT ought to be 26°40′

sin 40° = .642788	cos 40° = .766044
2 sin 20° = .684040	2 cos 20° = 1.879386
N = 1.326828	D = 2.645430

log N = .122815
colog D = 9.577503

log tan BOT = 9.700318
$\angle$BOT = 26°38′10″
discrepancy = 110″

PHYSICS

REFLECTION AND REFRACTION OF SPHERICAL SURFACES

REV. THOMAS H. QUIGLEY, S.J.

In a previous paper (Bulletin A. A. J. S. Vol. VII, No. 4) a proof was given for the formula for thin spherical lenses. A proof, similar in form, is now offered for the formula (eq. 5a below) which shows the relation between the distance of a point source of light and the distance of its image formed by reflection or refraction at a spherical surface.

In the present paper the formulae will be derived from figures in which the constants (n, c′, c″, f) and the distances of the object and its image are measured to the right of the spherical surface. Then, in order that the formulae thus derived may apply to reflection and refraction at spherical surfaces in general (i. e. for the different relative positions of surface, object, and image), the following convention for signs is adopted: **the numerical values to be substituted for the letters in the formulae will be positive if the quantities measured are to the right of the spherical surface; the numerical values are to be negative if the quantities measured are to the left of the spherical surface.**

Because of spherical aberration the formulae to be derived can only be approximate and will hold closely only when the faces are of small aperture. Hence use will be here made of the same approximate formula as was used in the previous paper (Bulletin VII, 4, p. 39) sc. sin (x ± y) = sin x ± sin y, (where x and y are very small angles).

Fig. 1

Fig. 2.

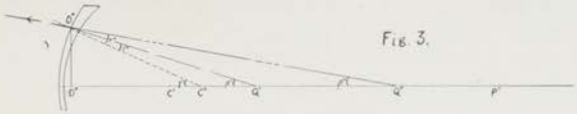


Fig. 3.

I. Reflection at a Spherical Surface.

Let P (in figure 1) be a luminous point, Q its image formed by reflection, i and r the angles of incidence and reflection respectively, C the center of curvature of the spherical surface, c the radius of curvature of the surface, p and q the distance of the object P and its image Q respectively from the surface.

From the Law of Regular Reflection $i = r$

Hence $\sin i = \sin r$ (eq. 1)

From figure (1) $i = \gamma - \alpha$; $r = \beta - \gamma$ (eq. 2)

If aperture is small, α, β, and γ will be very small angles (exaggerated in figure); and from equation (2) we obtain the following approximate

Equations: $\left\{ \begin{array}{l} \sin i = \sin \gamma - \sin \alpha \\ \sin r = \sin \beta - \sin \gamma \end{array} \right\}$ (eq. 3)

Substituting these values in (eq. 1): $\sin \alpha + \sin \beta = 2 \sin \gamma$ (eq. 4)

Since the aperture is small, OP and OQ will be approximately equal to p and q respectively. Let d represent the segment OD, perpendicular to the axis from O.

Then $d/p + d/q = 2\,d/c$

Therefore $1/p + 1/q = 2/c.$ (eq. 5)

II. Refraction at a Single Spherical Surface.

Let P′ be a luminous point, Q′ its image (virtual) formed by refraction, i′ and r′ the angles of incidence and refraction respectively, the index of refraction, C′ the center of curvature of the spherical surface separating the two media, c′ the radius of curvature, etc.

From the Law of Regular Refraction $\sin i' = n \sin r'$ (eq. 1a)

From figure (2) $i' = \gamma' - \alpha'$; $r' = \gamma' - \beta'$ (eq 2a)

If aperture is small: $\left. \begin{array}{l} \sin i' = \sin \gamma' - \sin \alpha' \\ \sin r' = \sin \gamma' - \sin \beta' \end{array} \right\}$ (eq. 3a)

Substituting these values in (eq. 1a), we have:

$n \sin \beta' - \sin \alpha' = (n - 1) \sin \gamma'$ (eq. 4a)

Since aperture is small: $n/q' - 1/p' = (n - 1)/c'$ (eq. 5a)

N.B. It is readily seen that equation (5a) reduces to equation (5) when $n = -1$. Thus equation (5) may be considered as a special case of equation (5a).

III. Successive Refraction at the Faces of a Thin Spherical Lens.

The total refraction of a ray of light through a thin spherical lens can be found quite readily by considering the refraction at the first and second surfaces successively. Hence, by the successive application of equation (5a), we can derive and approximate formula (eq. 6 below) which will show the relation between the distance of a point source of light and the distance of its image formed by refraction through the lens. It is necessary, however, to keep in mind: first, that the virtual image formed by the refraction at the first surface of the lens becomes the object (virtual object, if you wish), for the second surface; second, that if n represents the value of the index of refraction for the first surface (where the light passes from the outside medium into the lens), then 1/n will represent the value of the index of refraction for the second surface (where the light passes from the lens into the outside medium again). This latter statement is easily understood from the fact that n is equal to the ratio of the velocity of light in the outside medium to its velocity in the medium of the lens.

Then, for the first surface: $n/q' - 1/p' = (n - 1)/c'$ (eq. 5a)

And for the second surface: $(1/n)/q'' - 1/q' = [(1/n) - 1]/c''$

Or $n/q' - 1/q'' = (n - 1)/c''$ (eq. 5b)

where c″ is the radius of curvature of the second surface of the lens, and q″ is the distance of Q″ (the image of P′ formed by the two successive refractions at the faces of the lens).

Subtracting (eq. 5b) from (eq. 5a), we have:

$$1/q'' - 1/p' = (n - 1)(1/c' - 1/c'')$$

Representing, as is usual, the distance of the point source of light and its image (formed by refraction through a lens) by p and q respectively, we have the formula:

$$1/q - 1/p = (n - 1)(1/c' - 1/c'') \qquad \text{(eq. 6)}$$

Equation (5b) may, if desired, be also derived from the use of figure (3). In this figure the ray of light from P′ has already been deviated by the refraction at the first surface of the lens, (cf. fig. 2). Because of this deviation the ray of light, as it strikes the second surface of the lens, appears to come from Q′ (the image of P′ formed by refraction at the first surface). Q′ is, then, virtually the point source of light for the refraction at the second surface of the lens, and q′ is virtually the corresponding object distance.

From figure (3) $i'' = \gamma'' - \beta'$; $r'' = \gamma'' - \beta''$ (eq. 2b)

Recalling that 1/n will be the value of the index of refraction, and reasoning in the same manner as in the derivation of (eq. 5a), we obtain:

$$n/q' - 1/q'' = (n - 1)/c'' \qquad \text{(eq. 5b)}$$

IV. The Mirror and Lens Formulae.

Since the focal length (f) of a mirror or lens is the image distance corresponding to an object "at infinity" (i. e. the image distance of an object which is so distant from the spherical surface that the reciprocal of the object distance is practically equal to zero), equation (5) will give: $0 + 1/f = 2/c$. Hence, substituting in (eq. 5) for 2/c its equal 1/f, we have:

The **Mirror Formula:** $1/p + 1/q = 1/f$.

In the same way, for an object "at infinity" equation (6) will give $1/f - 0 = (n - 1)(1/c' - 1/c'')$. Hence, substituting in (eq. 6) for $(n - 1)(1/c' - 1/c'')$ its equal 1/f,

we have:

The **Lens Formula:** $1/q - 1/p = 1/f$.

RECENT BOOKS

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

BIOLOGY

College Botany, William H. Eyster, 1932,
Ray Long—Richard R. Smith, Inc., New York.

Jobs for the College Graduate in Science, 1932,
E. J. Menge. Bruce Publishing Co., New York.

Textbook of Human Phsyiology, 1932,
Krogh & Drinker. Lea & Febiger, Philadelphia, Pa.

Plant Physiology, 1932,
Edwin C. Miller. McGraw-Hill Book Co., New York.

Fundamentals of Insect Life, 1932,
Metcalf & Flint. McGraw-Hill Book Co., New York.

CHEMISTRY

An Introductory Course in Physical Chemistry, Rodebush,
Van Nostrand Co., New York, 1932.

Fundamentals of Physical Chemistry, Davies,
Blakiston's Son & Co., Philadelphia, 1932.

Recent Advances is Physical Chemistry, Glasstone,
Blakiston's Son & Co., Philadelphia, 1931.

Colloid Aspects of Food Chemistry and Technology, Clayton,
J. & A. Churchill, London, 1932.

Chemical Analysis by Ex-rays and its applications, von Hevesy,
McGraw-Hill Book Co., 1932.

Mechanochemistry and the Colloid Mill, Travis,
Chemical Catalog Company, 1932.

Polar Molecules, Debye,
Chemical Catalog Company, 1932.

The Donnan Equilibrium, Bolam,
Bell & Son, London, 1932.

Chemical German, Phillips,
Chemical Publishing Company, Easton, Pa., 1930.

Chemical French, Dolt,
Chemical Publishing Company, Easton, Pa., 1930.

Laboratory Manual of Electro-chemistry, Muller,
Routledge, London, 1931.

Colloids, Hedges,
Edward Arnold & Co., London, 1931.

PHYSICS

The Principles of Optics, Hardy & Perrin,
McGraw-Hill Co.

Electronics, R. G. Hudson,
John Wiley & Sons.

Electric & Magnetic Fields, Stephen S. Atwood,
John Wiley & Sons.

Acoustics and Architecture, Paul E. Sabine,
McGraw-Hill Co.

Mathematical and Physical Papers, Sir Joseph Larmor,
The Macmillan Co.

MATHEMATICS

An Introduction to the Theory of Canonical Matrices, 1932, H. W. Turnbull-A. C. Aitken. Blackie & Son, Ltd., Toronto, Canada.

BOOK REVIEWS

Fundamentals of Physical Chemistry by Earl C. H. Davies, Professor of Physical Chemistry, West Virginia University, with 78 illustrations, P. Blakiston's Sons Company, Inc., 1932. vi+370 pp. 14.5x21.5 cm.

This book purports to be designed for a course of two lectures and one three-hour laboratory period a week. It appeared in two earlier mimeographed editions. Three hundred and thirty three pages of text, in nineteen chapters, are followed by an appendix which contains nineteen experiments to accompany the text. After these come data on the vapor tension of water, the density of water between 0° and 40°C, the boiling point of water at pressures between 720 and 760 mm., indices of refraction, etc. At the end of each chapter are exercises and problems. The exercises consist of stimulating questions mostly non-mathematical, of which the following is an example:

"Would it be advantageous to use a lubricating oil which contains molecules with one end polar? Explain." This is at the end of the chapter on liquids.

The problems according to the author presupposes a knowledge only of algebra and general chemistry. No answers are given to the problems, which, in general, are simple enough. There are plenteous references to recent chemical literature in English, which should inspire the student with a desire to become acquainted with the library. The chapters on

Atomic Structure, Electrical Methods for pH, Colloids, Catalysis, Proteins and Body Catalysts deserve special mention.

The book is substantially bound, printed in clear, bold type, and contains many appropriate tables as in the illustration of the text and also as a basis for problems. This book should be quite helpful to students who intend to study medicine, as applications to biological and physiological chemistry abound. A human touch is added frequently throughout the book in the pictures of famous chemists, particularly those of our day, beneath each of which is found a short biographical note. The pictures are however, poorly printed in most instances, but the general effect is certainly commendable.

J. J. S.

Chemical Analysis by X-Rays and Its Applications. G. von Hevesy, Professor of Physical Chemistry, University of Freiburg. McGraw-Hill Book Co., Inc., New York City, 1932. v + 333 pp. 101 Figs. 15 × 23 cm. $3.00.

The present volume, the tenth in the series by the holders of the George Fisher Baker Non-Resident Lectureships in Chemistry at Cornell University, maintains the high standard of excellence set by those appearing previously. These lecturers are invariably outstanding men in their chosen fields and one can feel sure that their statements are authoritative.

Except for an Introductory Lecture on "The Age of the Earth," the book is divided into three very distinct, though related parts: "Analysis by Means of X-Rays," "The Discovery and Properties of Hafnium," and "The Chemical Composition of the Earth and the Cosmic Abundance of the Elements."

Part I gives not only the historical development of chemical analysis by means of X-rays with examples of the uses of such analyses, but detailed descriptions of the apparatus and procedures used, with comprehensive tables, making this a very valuable manual for any one actually doing work of this sort. In view of the importance of chemical analysis it would seem that all chemists and chemistry teachers should make themselves at least superficially familiar with methods such as those described here which show promise of displacing soon the usual chemical methods for large classes of analyses.

Part II gives a highly interesting account of the discovery of hafnium (the author being one of its co-discoverers), followed by a description of methods of separation and analysis and of the chemical and physical properties of the metal and its compounds.

In Part III are described and compared the methods used in arriving at a knowledge of the relative abundance of the elements in the earth and the rest of the solar system, with the results obtained.

The average chemistry teacher would be interested only in certain portions of this book, such as the Introductory Lecture, the chapters on "Origin of X-Ray Spectroscopy," "The Work of Moseley and His Fundamental Law Governing X-Ray Spectra," "The Discovery of Hafnium and Its Separation from Zirconium,'' and most of Part III. These portions may however be read understandingly without bothering about the more technical sections.

This volume offers a fine illustration of the way in which the three sciences of chemistry, physics, and geology are interrelated. Part I is chiefly physics, Part II chemistry, and Part III geology. It speaks well for the author's ability that he can lecture and write so authoritatively in all three fields (and in a foreign language, too)!

There are quite a few minor mistakes, most of them probably due to inadequate proof-reading. The frequent use of ''niobium'' in place of ''columbium'' might be confusing to some readers. More important are the incorrect plotting of the ''atomic radius'' of hafnium, making it appear less than that of zirconium, in Figure 79, and the incorrect values of the atomic volumes of hafnium and zirconium in Table XXI. Figure 83 not only is unintelligible without some explanation of the meaning of the symbols used but it represents a very improbable structure from the standpoint of crystal structure theory. (The structure analysis is by no means conclusive; *cf.* Ewald and Hermann, ''*Strukturbericht*,'' p. 454.) In general the illustrations are well chosen, well made, and well reproduced.

M. L. H.

(Continued from Page 59)

Fr. Strohaver. A dumb waiter has been installed for the purpose of conveying to the department various chemicals and machinery. An elevator for the use of faculty members will run the entire height of the building.

This readjustment of the university machinery will leave Healy building open for the maturing of a plan long contemplated by University officials, the establishing of all graduate work in that building.

The huge esplanaded building with its three approaches will have colonial brick from Winchester, Va., its decorative ruble stone from Port Deposit, Maryland, and golden stone from Cleveland. These beautiful pieces will be combined into facades of surpassing appeal, even the treads on the stairways will be composed of a beautiful composition, alberene. The ventilating system will completely condition the air and change it every three minutes and will be used in cool weather as a heating system by the turning of a valve permitting the distribution of properly warmed and humidified air. All piping in the building will be done with brass and copper pipe, so that this phase of the construction will be as nearly possible permanent as builders can make it. Sash weights to be used in the huge windows have already arrived and the windows will be installed as soon as the stone and brick work permit.

Landscaping

Mr. Joseph Toomey, superintendent of construction in charge of the building, said that some of the stone material to be used in the building was the most beautiful he had ever seen. He commented particularly on the stair treads of alberene, samples of which he has ready for the President's approval.

At the completion of the building the surrounding ground will be properly graded and scaped and the unit will take its place among the buildings of Greater Georgetown of which it is a part.

NEWS ITEMS

BOSTON COLLEGE.—CHEMISTRY DEPARTMENT

The enrollment in the Chemistry Department at Boston College this year has been the largest so far. The following figures will bear this out.

General Chemistry	390	students
Stoichiometry	135	”
Organic Chemistry	110	”
Qualitative Analysis	15	”
Colloid Chemistry	11	”
Organic Analysis	8	”
Physical Chemistry	6	”
Graduate Students	7	”
TOTAL	682	students

Quantitative and Volumetric Analysis are second semester courses. They will probably number between them fifty students, making a grand total for the year, apart from Extension Courses, 732 students.

The staff, which is assigned to care for the above students, numbers five professors and six graduate students working on part time fellowships.

Our big problem is to handle the large crowds who are taking General Chemistry in Freshman and Sophomore years. These meet in sections of approximately 120 students on Tuesdays, Wednesdays, and Thursday afternoons and are under the care of the Professor in charge of the course and six assistants.

CHEMISTRY LIBRARY

A new Chemistry Department Library has been opened on the third floor of the Science Building.

This Library is discussed in a separate article.

CHEMICAL BROADCASTS

The Northeastern Section of the American Chemical Society has asked members of the faculty at Boston College to assist in giving broadcasts over the Yankee Network to popularize chemistry and arouse an interest in it.

Recently, Mr. Brendan F. McSheehy gave a talk on "Emulsions". Father Sullivan spoke on October 27th on "Treasures from the Sea", and will speak again on November 10th on a second paper in that series.

Other broadcasts are scheduled to follow.

GRADUATE STUDENTS

Students in the Graduate Department number seven this year. The courses assigned them are Advanced Organic Chemistry, Kinetics, Electrochemistry, and attendance at various Seminars.

A reading knowledge of French or German is required and an examination in either one of these branches must be passed before December 1st. Preliminary written examinations begin November 25th. Preliminary oral examinations begin the week of November 28th.

Graduate students failing to pass these preliminary examinations are prohibited from continuing on towards their Master's Degree.

WOODSTOCK COLLEGE.—THE SCIENCE COURSES

The new program of Studies in Philosophy and Theology conforming with the requirements of the "Statuta Facultatum Theologiae et Philosophiae in Collegiis Societatis Iesu erectarum", recently issued, has necessitated considerable changes in the Science Schedule at Woodstock.

While the *Statuta* may be said to deal with Science only *in obliquis* by requiring five hours a week, for one year, for the study of scientific questions connected with Philosophy, and at least four semester hours devoted secondary education has provided those entering the Society with sufficient to Experimental Psychology, it presupposes that the equivalent of our knowledge of "general science" to satisfy the entrance requirements of the Faculty of Philosophy.

Since this is not universally true in this country, where some of our High Schools omit teaching either Physics, Chemistry, or both, it was necessary to make some provision for such prerequisite courses in the Physical, Chemical and Biological Sciences.

This has been done by introducing semester courses in the above mentioned Sciences, as well as Mathematics, in First Year Philosophy.

This provision has been approved by Very Reverend Father General and conforms with the requirement that the students have had at least what amounts to our "High School Science" before beginning the *two* years of Philosophy required by Papal Decree.

The Schedule in its details is only tentative, but for this year has been arranged as follows:

First Semester:	Chemistry, Lecture; Three hours a week. Laboratory; One two-hour period a week.
	Mathematical Analysis; Four hours a week.
Second Semester:	Physics; Lecture only; Five hours a week.
	Biology; Lecture; Two hours a week.

As this is a transition period the new order applies *in toto* only to First Year men. Second Year Class will also take the Physics course (this year only) in second term. The required Experimental Psychology is given in Second Year first term.

The usual Academies for Second and Third Year are also retained for 1932-33;—Calculus (two hours a week, two terms), Organic Chemistry, and Laboratory Physics, for third year only. Geology and Astronomy have been made electives.

Beginning next year it will be possible for those electing some branch of science as one of the "Disciplinae Speciales" (provided for in the Statuta, with a view to the needs of the countries concerned), to continue the same throughout Second and Third Year; an advantage not had under the old regime.

It is interesting to note (merely as a coincidence) that Woodstock is not alone in introducing such general courses as part of the Collegiate curriculum.

The University of Chicago, after a complete revision of its system of education in 1931, offers just such a course in the Physical Sciences, including Physics, Chemistry, Astronomy, Geology and Mathematics,—to be covered by lectures totaling not over one hundred hours. This is followed by "alternate courses" in the individual sciences in Sophomore. Thus before beginning the last two years of College the student has a general knowledge of the more important Physical Sciences, and a good foundation (from his second year work) in the particular Science in which he intends to major.

To those who are dubious about the practicability of such a scheme I would suggest writing to the University of Chicago Book Store, 5802 Ellis Ave., Chicago, Ill., for copies of the Syllabus of the Introductory General Course in the Physical Sciences; the Syllabus for Alternate 2d year Sequences in College Physics, as well as the Comprehensive Examinations given in these Introductory Courses in 1931-32.

LOYOLA COLLEGE, BALTIMORE, MD.—CHEMISTRY DEPARTMENT

On November 15, Dr. W. Mansfield Clark, Professor of Chemistry at The Johns Hopkins Medical School, delivered an illustrated lecture on "Oxidation and Reduction."

The Chemists' Club was favored with the extraordinary privilege of a demonstration and lecture by Dr. Benedetti-Pichler and Dr. Joseph B. Niederl of the University of Graz, Austria. The subject: "Special Topics in Micro-Chemistry." Professors of nearby Universities and the National Bureau of Standards attended the lecture.

Other Lecturers on the programme for the Scholastic year are: Dr. Francis O. Rice, Dr. Wm. M. Thornton, Dr. Joseph C. W. Frazer, Dr. Walter A. Patrick, Dr. Donald H. Andrews, of The Johns Hopkins University; Dr. Charles S. Piggott, Geophysical Laboratory, Carnegie Institution of Washington, D. C.; Dr. Herbert Insley, National Bureau of Standards and Dr. J. H. Shrader, Director of Research of the National Dairy Products Corporation.

New apparatus included a Carl Zeiss Polarizing Microscope and a Wm. H. F. Kuhlmann Micro- Balance.

A new Physics text has been adopted for all Junior A.B. and Ph.B. classes. It is "An Introduction to Physical Science," by Professor Car. W. Miller, of Brown University. For Junior B.S. work, Robertson's "Introduction to Physical Optics" has been chosen.

A light intensifier and earthquake signal designed by Father J. S. O'Conor, S.J., is being tried out by Father Frederick W. Sohon, S.J., Director of the Georgetown Seismological Observatory. Weston Electric Company supplied a Special High-Sensitivity Model 594 "Photronic" Photoelectric Cell, and two power relays (Dwg. 68690). The Weston Galvanometer Relay was rewound to 1700 ohms. The operation is as follows: A Spencer Universal Microscope Lamp (No. 358) throws a beam of light on the galvanometer mirror, which focuses it on the photoelectric cell. The latter then opens the contact of the galvanometer relay. If the recording galvanometer swings, the light spot wanders off the photoelectric cell. The galvanometer relay then closes a circuit which contains the two power relays in series, and is energized by a small rectifying transformer. When this circuit is closed, one relay lights a bulb on the telephone switchboard, while the other short circuits a one ohm resistance in series with the lamps of the recorder, and thus increases their intensity. In this way, a disturbance turns up the lights on the recorder and at the same time gives a warning to the telephone operator. There are two disadvantages. The auxiliary lamp housing spews light about in the dark room and fogs the paper, and the lamp itself burns out in about a fortnight.

In preparation for the World Longitude Determination program for November 1933, when Georgetown College Observatory will again constitute a link in the worldwide chain of secondary longitude stations,—the Observatory has acquired a Hammerlund Comet Pro Short Wave superheterodyne receiver designed for 1.5 to 20 megacycles. Father Joseph W. Daley, S.J., personally engineered the erection of two antennae, and due to their orientation and careful construction, it will probably not be difficult to receive time signals from any of the fundamental stations. One of the antennae is an all-purpose antenna 30 feet high with an over-all length of 555 feet, pointing North-East. This line passes through or near Nauen and Koenigswusterhausen (Berlin); is but four degrees off Chelmsford, England; and is 11 degrees off Rome (I2RQ) and Vatican City (HJV),—the stations most desired. To the South-West it passes through Mexico City (XDA). The second antenna is a dipole or doublet with transposed leads, one-quarter wave length, 19.9 feet long, with a natural frequency of 11758.8 Kilocycles. This corresponds to a frequency just between 11,760 Kc., of GMBH, Koenigswusterhausen, Germany; and 11750, the frequency of GBSW, Chelmsford, England. This antenna will be used exclusively for short wave work.

All-night observations are to be made from November 13 to the 17th for the scheduled reappearance after 33 years of the famous shower of Leonids. A number of cameras with rapid lenses will be used to point in slightly different directions so as to cover a large area of the sky around the radiant point in the Constellation Leo. The paths of the meteors will also be recorded on charts drawn on the gnomonic projection. On such charts all lines observed as straight in the heavens, are still straight, in spite of being now seen on a flat surface.

A type 212 comparator or measuring engine for astrographic and spectrographic plates as large as 200x200 mm., was received from the Societe Genevoise d'Instruments de Physique, and has been installed in the Georgetown Observatory for use in very accurate measurements of stellar coordinates. The reading drums are graduated directly in thousandths of a millimeter, thus making possible the estimation of ten-thousandths of a mm; and the circular plate-holding table reads to one minute of arc in determining the polar coordinates of points on the plate.

Distinguished astronomers who have recently visited Georgetown, include: Father John W. Stein, S.J., Director of the Vatican Observatory, Vatican City, Italy; Father Paul LeJay, S.J., Director of Zikawei Observatory, Shanghai, China; Father Luis Rodes, S.J., Director of the Observatory of the Ebro, Tortosa, Spain; and Dr. August Kopff of the Astronom. Recheninstitut, Berlin-Dahlen, Germany.

Father Paul A. McNally, S.J., Director of the Georgetown College Observatory, is being besieged with requests for prints of the Fryeburg eclipse plates, many of the requests coming from well-known observatories like the Dominion Astrophysical Observatory in Vancouver, the Yerkes Observatory of the University of Chicago. It seems that the Georgetown picture published in the November *National Geographic Magazine* was the best one secured by any of the seventy-odd eclipse expeditions; and the letter from the Yerkes Observatory pronounced it the best coronal picture and the richest in detail since the famous one taken by E. E. Barnard and G. W. Ritchey on May 28, 1900. The astrographic cameras mounted on the 5″ visual telescope have now been replaced and accurately adjusted on their pier at the Observatory.

GEORGETOWN UNIVERSITY—CHEMISTRY DEPARTMENT

The Non-Resident Lecturers for the present scholastic year include: Dr. W. J. Humphreys, United States Weather Bureau; Mr. J. Barab, Hercules Powder Co.; Rev. G. F. Strohaver, S.J.; Dr. Wm. Blum, National Bureau of Standards; Dr. Herbert Insley, National Bureau of Standards; Mr. Henry D. Hubbard, National Bureau of Standards; Dr. Edward G. Lunn, Naval Research Laboratory; Maj. Gen. Harry L. Gilchrist, U. S. A., Chemical Warfare Service; Dr. Graham Edgar, Ethyl Gasoline Corporation; Mr. Frederick J. Bates, National Bureau of Standards; Dr. Arnold K. Balls, Bureau of Chemistry and Soils; Mr. William D. Collins, United States Geological Survey; and Dr. Paul Heyl, National Bureau of Standards.

FORDHAM UNIVERSITY.—BIOLOGICAL DEPARTMENT

In the latter part of October, of this year, a practice was inaugurated which it is hoped will become an annual institution at Fordham. The

Mendel Club, whose membership is composed of students interested in Biology, staged a demonstration lecture for the benefit of the seniors in psychology who had not had a course in Biology. This offered an ideal way in which to supplement, with visual aids, the textual matter already received.

The lecture consisted of a thorough explanation of mitosis, maturation, fertilization, cleavage and the development of the embryo up to the gastrula stage. Numerous slides were viewed through the microscopes by the students. All phases of mitosis, in both plant and animal tissues, were viewed in this manner. Advantage was taken of the small chromosomic content in the Ascaris megalocephala. The segmenting eggs of this parasitic worm, whose chromosomic number is two, clearly portrayed the various steps of cleavage. The early forms of the development of the embryo was demonstrated by means of wax models, which showed, with unusual clearness, the steps in the formation of the three primary germ layers.

Mr. David A. Connors, Jr., President of the Mendel Club, through whose efforts the meeting was held, was materially assisted by the members of the faculty of the Biology Department, to whom the success of the meeting is largely responsible. Dr. Mark T. Crowley, Professor of Histology and Embryology, delivered the explanation of animal mitosis, maturation, fertilization, and embryology. Professor William Bonisteel, of the Department of Botany, in the Fordham Graduate School, explained plant mitosis.

Judging from the enthusiastic reception which more than one hundred and fifty members of the senior class accorded the meeting, the demonstration was successful in every way. Rev. Joseph A. Murphy, S.J., Professor of Psychology, expressed great satisfaction that so many students were interested enough to voluntarily sacrifice their own time in order to further their knowledge of the subject matter.

The Biology Department is further enriched by the many specimens brought back from a recent trip to Germany, such as: a set of five vertebrate hearts, eight vertebrate brains, mounted specimens showing the difference between marrow filled and air filled bones, mounted specimen of typical vertebrae of the vertebrates, also a number of various charts to augment our already rather complete collection. The Department is also equipped with the latest model Sartorius microtome desk size, which is a very cheap and serviceable instrument.

LOYOLA HIGH SCHOOL, Baltimore, Md. The Faculty in the Science Department is the same as 1931-1932. The enrollment in the Science Classes is as follows: Chemistry, seventy-six students; Biology, seventy-one students; Physics, nineteen students.

MANILA OBSERVATORY, Manila, P.I. There was a severe earthquake in Baguio on August 24th that damaged the seismograph at the Mirador Observatory. Rev. William C. Repetti made an inspection tour of the seismographs located on the Island of Guam. Rev. Henry C. Avery, Professor of Biology of the Ateneo de Manila was in the hospital several weeks suffering with ascaris lumbricoides.

CANISIUS COLLEGE.—PRE-MEDICAL CLASSES

To afford our students a better preparation for the annual aptitude tests conducted by the Association of American Colleges the Dean of Studies is conducting a series of intelligence and mechanical aptitude tests. It is felt that the formal training in the pre-medical sciences leaves something to be desired in the mental equipment of the student and we shall note with interest the development of this experiment. In the conduct of these examinations the Reverend Dean has enlisted the cooperation of the Professor of Education.

Negotiations are also in progress to secure several men prominent in medical circles to lecture to the pre-medical students on subjects of current interest in medicine.

BIOLOGY DEPARTMENT

Registration in the biology classes for the present semester is considerably below last year's high level. The falling off is due entirely to a decreased registration in freshman pre-medical. Whereas last year there were eighty in the freshman class this year's totals fifty-five.