A. M. D. G.

BULLETIN

of the

American Association of Jesuit Scientists

Eastern States Division

(Founded 1922)

(for private circulation)

INCLUDES
PROCEEDINGS
OF THE
TWENTY-EIGHTH ANNUAL MEETING
August 31, September 1 and 2, 1953
ST. JOSEPH'S COLLEGE

Published at
BOSTON COLLEGE
Chestnut Hill, Massachusetts

Vol. XXXI | OCTOBER, 1953 | No. 1

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Bulletin of the American Association of Jesuit Scientists

EASTERN STATES DIVISION

VOL. XXXI — OCTOBER, 1953 — NO. 1

NOTICE TO AUTHORS

Manuscripts are to be submitted to associate editors of the appropriate section and *may* be submitted directly to the editor in chief. Clear manuscript, preferably typed, with wide margin to the left, with double spacing between lines, is desirable. Please try to follow the typographical style of the most recent issue of the BULLETIN. Line drawings should be submitted on Bristol board, or similar material, and done in India ink. Figure number should be written on this in pencil. Titles for drawings, with figure numbers, should be typed on a separate sheet. Please try to minimize footnotes. Appended references and bibliographies, clearly so marked, should be done in the style of the A.A.A.S. publication, *Science*.

Program

Twenty-eighth Annual Meeting
of the

AMERICAN ASSOCIATION OF JESUIT SCIENTISTS
EASTERN STATES DIVISION

ST. JOSEPH'S COLLEGE

August 31, September 1 and 2, 1953

FIRST GENERAL MEETING

Monday, August 31, 1953 at 7:30 P.M. in Lonergan Building

Address of Welcome — Rev. F. Joseph Kerr, S.J.
Minister of St. Joseph's College

GUEST ADDRESS: Cosmic Rays — Dr. W. F. G. Swann
Director—Bartol Research Foundation

MEETINGS OF THE SECTIONS

BIOLOGY SECTION

Cold Acclimatization Studies	George F. Lawlor, S.J.
Artificial Hibernation	Mark H. Bauer, S.J.
Population Studies—Their Bearing on Evolutionary Processes	J. Franklin Ewing, S.J.
Biologist in the Making	Michael P. Walsh, S.J.
Mechanism of Photosynthesis	James A. McKeough, S.J.
General Discussion: The Textbook and Content of a Course in General Biology for Non-Science Majors	Francis X. Wilkie, S.J. Chairman

CHEMISTRY SECTION

The Rare Earth Elements	Alvin A. Hufnagel, S.J.
Paper Electrophoresis	Joseph A. Duke, S.J.
Formula for Indirect Gravimetric Analysis	Bernard A. Fiekers, S.J.
Recent Trends in Catalysis Research	Clarence C. Schubert, S.J.
Radioisotopes	Vincent F. Beatty, S.J.
Westinghouse Fellowship Grant at Carnegie Tech.	John F. Devine, S.J.
A Light Integrator for the Spectograph	George J. Hilsdorf, S.J.
Various Forms of the Periodic Table	Joseph A. Martus, S.J.

Report on ACS Chemistry Workshop at Penn. State	Gerald F. Hutchinson, S.J.
Thermal Decomposition of Ethane	Robert E. Varnerin, S.J.
Effect of Varying Cross-linkage on Cation-Exchange Equilibria	James J. Cowgill, S.J.
Magnetochemistry	William H. McBride, S.J.
Methods of Determining Dipole Moments of Compounds	Paul J. McCarthy, S.J.
Chemistry at Baghdad College	Joseph L. Ryan, S.J.
Calibration of a Large Volumetric Flask	Albert F. McGuinn, S.J.
The Effects of Thyroxis on Nucleic Acids	Miguel M. Varela, S.J.
Carbon Cycle in Nature	Bernard M. Scully, S.J.

MATHEMATICS SECTION

An Introduction to Fourier Series	Frederick Koehler, S.J.
Foundations of Elementary Algebra and Calculus	Philippe Dionne, S.J.
Development and Scope of Topology	John J. MacDonnell, S.J.
Congruences	John W. Green, S.J.
Simple Example of Topological Mappings	Charles Lewis, S.J.
Computation with Approximate Numbers	Joseph A. Persich, S.J.

PHYSICS SECTION

Toward an Effective Twentieth Century Cosmology	Joseph T. Clark, S.J.
Some Research Problems for Jesuits	Francis J. Heyden, S.J.
Molecular Spectroscopy	James J. Devlin, S.J.
Transistors—Their Operation and Application	James J. Ruddick, S.J.
Absorption in Liquids by the Pulse Method	John A. Tobin, S.J.
Modes of Vibration of a Rotating String	John S. O'Conor, S.J.
Ultra Absorption in Water-Hall Theory	Stanley J. Bezuszka, S.J.
Astrophysics Symposium at the University of Michigan	Frederick L. Canavan, S.J.
A "New" Interpretation of Quantum Mechanics	Robert O. Brennan, S.J.
The Spectrum of Mercury 198	Joseph F. Mulligan, S.J.

SECOND GENERAL MEETING

Tuesday, September 1st at 2:00 P.M. in Lonergan Building

GUEST ADDRESS: *Radioisotopes—New Tools of Research* — Edwin A. Wiggin, *Chief, U.S. Atomic Energy Commission*

THIRD GENERAL MEETING

Tuesday, September 1st at 7:30 P.M. in Lonergan Building

GUEST ADDRESS: *The Evolution of the Universe*
(Tape recording with slides)

Dr. George Gamow, Ph.D.
George Washington University

Motion Picture (March of Time): *Georgetown Observatory.*
Presented by Francis J. Heyden, S.J.

FINAL GENERAL MEETING

Wednesday, September 2nd at 9:30 A.M. in Lonergan Building

ADDRESS: *The Atom and the Cross* — John P. Delaney, S.J.
Report of the Secretary — Joseph F. Mulligan, S.J.
Report of Committee on Resolutions
Report of Committee on Nominations
Election of Officers

SECRETARY'S REPORT

First General Session

The twenty-eighth annual meeting of the AMERICAN ASSOCIATION OF JESUIT SCIENTISTS, Eastern States Division, was called to order at 7:30 P.M., August 31, 1953, in the Physics Amphitheatre of St. Joseph's College, Philadelphia, Pa. This was the first meeting of the Association to be held in Philadelphia. Rev. John S. O'Conor, President of the Association, introduced Rev. F. Joseph Kerr, Minister of St. Joseph's College, who in the name of Rev. Edward G. Jacklin, President, welcomed the delegates to the college.

Father O'Conor read a few general announcements and then introduced the guest speaker of the evening, Dr. W. F. G. Swann. Because of the presence of the guest-speaker, all other business was postponed until the final general session.

The following committees were appointed:

Committee on Resolutions	*Committee on Nominations*
Rev. Arthur Coniff	Rev. Bernard Fiekers
Rev. Stanley Bezuszka	Rev. John Frisch
Rev. Frederick Canavan	Rev. Frederick Sohon

Final General Session

Before the business session commenced, Rev. John P. Delaney of Loyola College, Baltimore, read a paper entitled "The Atom and the Cross," which pleaded for more Catholic scientists and emphasized the responsibilities of the members of the Association in turning the minds of capable students to careers in science. This paper provoked an unusual amount of interest, and comments from the floor were made by Fathers O'Conor, Brennan, Mulligan, Hilsdorf, Fiekers, Hutchinson, Clark, Duke, M. Walsh, J. Ryan and by Mr. Haig.

The final business meeting was called to order by the President at 10:15 A.M. in the Physics Amphitheatre. After a few announcements, a proposal was made that the minutes of the 1952 meeting be accepted as they appeared in the October, 1952, BULLETIN. This motion was seconded and passed unanimously. In the absence of the Treasurer, Rev. Edward Berry, the Treasurer's report was read by the Secretary.

The Secretary brought up the question of the membership list of the Association. It was voted that the membership list published in the March, 1953 BULLETIN be accepted as the official membership list of the Association. This list will be amended by the election of new members by the Executive Council each year, in accordance with the constitutions.

Father John McCarthy spoke briefly on the BULLETIN and urged all to give him abstracts of their papers presented at the meeting.

Father Stanley Bezuszka read the report of the Committee on Resolutions as follows:

1. Be it resolved that the American Association of Jesuit Scientists (Eastern States Division) express its sincere gratitude to the Rev. Edward G. Jacklin, President of St. Joseph's College, to Rev. F. Joseph Kerr, Minister, and to the community of St. Joseph's College for their cordial reception and gracious hospitality shown the Association during its meeting.
2. Be it resolved that the Association express its heartfelt thanks to Rev. John S. O'Conor, President, and to the officers of the Association for their thoughtful generosity that made the meeting a success.
3. Be it resolved that the Association express its heartfelt thanks to Dr. W. F. G. Swann, to Dr. George Gamow, and to Mr. Edwin A. Wiggin, whose guest addresses contributed so much to the success of the meeting.
4. Be it resolved that the Association express its continuing appreciation of the work of Rev. John J. McCarthy as Editor-in-Chief of the BULLETIN.
5. Whereas this Association has, on the death of Fathers Domhnall A. Steele, Lawrence C. Gorman, and Joseph J. Sullivan, lost most loyal members and devoted colleagues in the field of science, be it resolved that the Association express its profound regret at this loss.
6. Be it resolved that the Secretary of the Association be instructed to send a copy of these resolutions to Rev. Father Rector and Father Minister of St. Joseph's College, a copy of the resolution on Father Steele to the Rev. Fathers Provincial of the New

York and the English Provinces, and a copy of the resolutions on Fathers Sullivan and Gorman to their nearest relatives.

Signed: Stanley J. Bezuszka, *Chairman*
Fred L. Canavan
Arthur A. Coniff

Father Fiekers then read the report of the Nominating Committee as follows:

For President: Rev. Thomas J. Smith.

Father Smith was elected by an unanimous vote of those present.

Father Smith then assumed the chair, and since there was no further business the meeting was closed with a prayer.

Respectfully submitted,

(Rev.) Joseph F. Mulligan, S.J.
Secretary

THE ATOM AND THE CROSS

John P. Delaney, S.J.

Our title is plagiarized for a purpose, to make the same point as in the Catholic Digest article of August 1953, where Mr. Thomas E. Murray of AEC publicizes once again the scarcity of Catholics among atomic scientists. This disturbing comment from Mr. Murray stems from zeal for better science education in Catholic schools. Less friendly writers in Science, Science Monthly, etc, have elaborated statistics on the scarcity of Catholic scientists citing these statistics as proof of antagonism between religion and science.

Many such embarrassments continually plague Catholic education. Another is the largely publicized annual competition for Westinghouse science scholarships which attracts nearly twenty thousand for scholarships awarded in colleges of the students' choice. Representatives from Catholic high schools are notably missing from this competition and consequently Catholic colleges have no Westinghouse scholars.

All Catholic educators should be gravely concerned by this situation because it depreciates publicly all Catholic education. Some discussion has appeared in Jesuit Educational Quarterly by Frs. O'Leary, Mulligan and Yancey, and these fine papers should be studied by every conscientious Catholic educator.

Among the proposed solutions has been the building of million dollar cyclotrons in Jesuit colleges. But there has been no complaint of Catholic colleges lacking in cyclotrons but rather of Catholic scientists to assist in the interpretation of data from cyclotrons. The country faces a grave manpower shortage of research scientists, as distinct from engineers and technicians. Scientists originate mostly in the liberal arts colleges, rather than engineering schools, the product of major courses in biology, chemistry, mathematics and physics. Therefore it would seem that a solution of the present shortage of scientists, especially of Catholic scientists, should be simple and obvious, the counselling of greater numbers of talented students into science courses and the promising careers open to them in science. Students have a right to this wise counsel, and in the present crisis the good name of Catholic education demands it. Catholic colleges generally are equipped well for undergraduate major courses in biology, chemistry and physics, and a survey just completed has revealed only three Jesuit colleges not offering a major course in physics. To fill the shortage of manpower in science, greater numbers of talented students must take advantage of these facilities offered them.

There is no antagonism between science and religion, but unfortunately some Catholic educators are thoughtless toward science, a thoughtlessness which then infects Catholic students from First High to college Senior. Jesuit scientists have a responsibility toward correcting this thoughtlessness, and toward promoting a more zealous scientific interest in Jesuit schools among both faculty and students. Jesuit scientists should alert their deans and student counsellors to the shortage of scientists, especially Catholic scientists. They should stimulate scientific interest in their communities by commending an interesting bit of science for refectory reading, and a good publication, like Scientific American or Science Counsellor, for the recreation room table. Such enlivened interest in the science apostolate would eventually draw Catholic students in greater numbers to careers in science.

This more thoughtful interest in science is expected of all educators and leaders. St. Ignatius set an example when in his letter on Obedience he drew from the science of astronomy his inspiring reflection on the order in the heavenly bodies. Likewise Bishop Fulton Sheen owes much of his power and effectiveness to his frequent diversions into science. An awakened Jesuit interest in science would not only inspire more Catholic students toward science careers, but it would also enrich Jesuit sermons and retreats and impress the people more favorably toward Jesuit learning. The world is awe-struck by atomic energy, space-ships, and the daily advance in science.

No, it is not due to shortage of cyclotrons in Jesuit colleges or to shortage of science faculties that thousands of Catholic boys are lost to careers in science. Most are lost through thoughtlessness, some through ill-advised selection of Greek rather than science for their high school course, others through lack of wise counsel in college. Catholic students in all courses have a right to an educated interest in science and to an appreciation of the glorious Jesuit heritage in science, Frs. Kircher, Grimaldi, Ricci, Secchi, Wasman, and a host of others, and of that greatest of Jesuit alumni in science, Descartes. Refutation of Cartesian philosophy should occasion instructive appraisal of his mathematical genius.

Present day Jesuit scientists are laboring hard to supply the alarming need for scientists, especially Catholic scientists. Their labors have not passed without notice. Some fifty of them have been included in American Men of Science, many also are noted in Catholic Who's Who, and also some are notarized in Who's Who in America. They have sent many graduates into science careers and have given the lie to the cry of antagonism between religion and science. But much remains to be done. Jesuit scientists could accomplish more with the wise support of science-minded confreres counselling talented students in greater numbers on the wide open opportunities due to shortage of scientists. Thus might be filled the embarrassing shortage of Catholic scientists.

References

O'Leary, Timothy J., S.J. The Role of Science in Jesuit Colleges. *Jesuit Educational Quarterly*, March 1953, p. 223

Mulligan, Joseph F., S.J. Preparation in Natural Sciences and Jesuit Colleges *ibid.*, p. 229

Yancey, Patrick H., S.J. Catholic Science and Science Programs. *Jesuit Educational Quarterly*, June 1953

Biology

COLD ACCLIMATIZATION STUDIES

(Abstract)

George F. Lawlor, S.J.

The effect of temperature on living organisms is of great significance and importance. In recent years cold acclimatization studies have come into considerable prominence. This is partly due to the economic and military importance of Alaska and the need for a correct therapy in treating cold injury following cold exposure which frequently occurs in high altitude flying. In addition adaptation or acclimatization to life at different temperatures and climates otherwise lethal has been an important factor in animal distribution and thus an intriguing subject of investigation. Such adaptation is quite interesting in warm blooded animals since they must maintain a steady internal temperature. One of the mechanisms of temperature regulation is physical in which the transfer of heat is increased or decreased. In mammals the thickness of fur and layers of fat other than food reserve are adaptations which are part of the physical regulation of temperature. When this physical mechanism does not adequately maintain body temperature a chemical mechanism is stimulated. There is a temperature sensitive center located in the brain which is thought to act like a thermostat regulating heat retention and heat loss. One of the general responses to low temperature exposure is an increase in metabolism. Acclimatization alters this metabolic response and thus appears to be important in the maintenance of an adequate internal temperature. It could be the essential mechanism of adaptation and defense against cold stress which in many cases means survival. Maybe future studies of individual tissue metabolism following acclimatization will reveal the solution to this problem.

ARTIFICIAL HIBERNATION

(Abstract)

Mark H. Bauer, S.J.

Among the factors which are thought to induce the torpid state in natural hibernators are: hypoglycemia, starvation, desiccation, anesthesia, increased blood magnesium. Experiments were described in which these conditions failed to produce hibernation in homoiotherms. The neural basis of temperature control was explained and attempts to disturb this control apparatus were described. Destruction of the parts of the hypothalamus associated with temperature control, high transection of the spinal cord, complete sympathectomy and the use of autonomic blocking substances allow the body temperature of homoiotherms to be lowered by the application of external cold. The usefulness of such a preparation for physiological and medical studies was discussed.

A BIOLOGIST IN THE MAKING

(Abstract)

M. P. Walsh, S.J.

The need for more Catholics in the biological sciences was discussed. The results published by Knapp and Goodrich in their book, Origins of American Scientists, were reviewed and a recent article by Pleasants in the August 28 issue of Commonwealth on the dearth of Catholics in Science was also discussed. More pragmatic reasons like socioeconomics factors were believed to be responsible for the relatively small number of Catholic scientists in recent decades. The explanations offered by these other authors were considered to be too speculative and of very little importance in directing individuals to a choice of a scientific career. More vocational counselling on the high-school level would help to increase the number of Catholics in Science. The introduction of research projects for selected Seniors, attendance at student science conventions, summer positions at research laboratories, lab assistantships were suggested at possible ways of influencing students to enter fields of scientific research.

MECHANISM OF PHOTOSYNTHESIS

(Abstract)

JAMES A. MCKEOUGH, S.J.

After defining the term photosynthesis, we divided the paper into two sections—photo and chemo synthesis in green plants. In the first part we cited the work of Ruben who used radioactive oxygen to determine that oxygen is derived from water and not carbon dioxide. The quantum controversy of Warburg and Emerson was mentioned as well as the recent one quantum reaction that has been demonstrated by Burk. Electron micrographs of the intimate structure of chloroplasts and grana were presented to those at the meeting along with other prepared charts and diagrams to illustrate the photo and chemo processes. In the second part of the paper we placed special emphasis on the work of Calvin of the University of California. His methods especially the use of paper chromatography and x-ray film to identify the intermediate compounds were cited in some detail. His important discovery is the fact that the first compound formed is phosphoglyceric acid. Finally his theory of the mechanism of photosynthesis was given in full. The importance of 6, 8 thoictic acid (sometimes called protogen or pyrucic acid oxidase factor) in this mechanism was emphasized. Briefly this is Calvin's present theory: Quanta of light are absorbed by the chlorophyll molecules. This light energy is then accepted by the thoictic acid which is activated to react with water to form thiol sulfenic acid. One molecule of this acid is reduced to dithiol, a powerful reducing agent for carbon dioxide reduction. Another molecule of this acid is oxidized to a system near the level of hydrogen peroxide from which oxygen is derived.

Chemistry

THE RARE EARTH ELEMENTS

(Abstract)

ALVIN A. HUFNAGLE, S.J.

The so-called Rare Earth Elements are a group of 15 (atomic numbers 57-71) all of which seem to fit in the same spot in the Periodic Chart, between Barium and Hafnium. To these are added two more, Scandium and Yttrium, because they occur in the same vertical column in the chart, have similar chemical properties and are always found associated with the other fifteen. The reason for

similarity of properties is that their external shell is identical, the difference being in two internal shells, in the 4f and 5d type electrons. The two most striking peculiarities of these elements are: first, they have almost identical chemical properties so that it is impossible to separate them quantitatively from each other and only a small percent of each element may be obtained in pure form. The only ways of separating them from one another is by means of thousands of fractional precipitations or crystallizations. If one wishes to get at least a visible amount of each of them in a pure form, it is necessary to start with about 100 kilograms of rich minerals. Secondly, about seven of them show a line absorption spectrum.

The rare earths have many uses both in the laboratory and in industry. They are used as catalysts to speed up chemical reactions. Gadolinium, because of its paramagnetic properties, is used in very low temperature research. Small amounts of Cerium mixed with Thorium are used in the famous Welsbach mantle. Thirty percent Cerium and seventy percent Iron are the constituents of lighter flints. Praseodymium and Neodymium are used to color porcelain. Neodymium is mixed with glass to cut down glare.

A FORMULA FOR INDIRECT GRAVIMETRIC ANALYSIS

(Abstract)

Bernard A. Fiekers, S.J.

A two-component mixture of salts with a common ion, such as NaCl and KCl, can be analyzed by calculating sample weight and AgCl product weight data according to the formula: $\%_{NaCl} = 100 (R - f_{KCl})/(f_{NaCl} - f_{KCl})$, in which the *f* terms are appropriate factors for AgCl *in* the salt designated by the subscript, and R is the weight of AgCl product per gram of sample. Since factors for the components commonly encountered are of high precision, generally based on atomic weights with five significant figures, the burden of precision in such determinations rests on the determination of R experimentally and few precision losses are to be expected from dropping insignificant figures in arithmetical operations which are here reduced to the minimum. Error studies are elucidated by graphing the two-component system with factors as ordinates and additive percentages as abscissae. R is in reality a linear weighted average of the two factors invloved. The percentage composition can be read off at the value of R. The less the difference between the two factor values, the less the slope of the line connecting them, and hence the less the certitude of the percentage composition corresponding to R. Further, high percentage error in percent is to be expected in the determination of components which are present in low percentage value. The treatment here given departs from previous treatment by Caley (*J. Chem. Educ.*, 6, 1979 (1929)), and the quantitative texts of Willard and Furman (and

Flagg), in that all problems are reduced to one gram quantities; further, an algebraic justification of the formula, which appears in this paper, seems to improve on the logically derived ratio and proportion statements of these authors.

RECENT TRENDS IN CATALYSIS RESEARCH

(Abstract)

CLARENCE C. SCHUBERT, S.J.

The role played by small amounts of impurities which enhance the catalytic activity of partially reduced oxides of transition elements is now being investigated. Catalytic materials are usually semi-conductors. For example, the amount of Cesium which is added to the Thoria of a gas mantle must be kept to a definite small percentage for optimum luminosity. The valence condition of an oxide catalyst is related to the specificity of a catalyst. WO_3 is a dehydrating catalyst, whereas WO_2 is dehydrogenating. The base upon which the catalyst is applied is responsible in large measure for the valence. Valence induction of NiO which is mixed with MgO, Al_2O_3, and TiO_2 is easily demonstrated by the colors produced, light green, black, and brown respectively. NiO contains excess oxygen in the lattice, active ZnO contains excessive Zn. Non-stoichiometry is the rule rather than the exception.

A LIGHT-INTEGRATOR FOR THE SPECTROGRAPH

(Abstract)

G. J. HILSDORF, S.J.

Two spectrograms of a D.C. arc can differ greatly in exposure even though the timing has been exactly the same. The arc wavers with the result that the quantity of light per interval of time is not always the same.

Using an instrument built at St. Peter's College nine spectrograms have been obtained on the same film which cannot be distinguished with the naked eye. The light falling on a chrome plated sector plate is reflected to a photo electric cell. The cell discharges a condenser which, when discharged, releases a magnetic gate over the slit. Using the same condenser all spectrograms are of the same density since the gate will close only after a definite quantity of light has entered the slit. Since samples differ, a selection of condensers is made available.

THE VARIOUS FORMS OF THE PERIODIC TABLE

(Abstract)

JOSEPH A. MARTUS, S.J.

This was a slide lecture-demonstration of various forms of the Periodic Table. Most of the forms were drawn from articles in the

Journal of Chemical Education published over the past twenty-five years. In general it was shown that the authors, in devising the various forms of the Table, were intent on improving on existing forms, or emphasizing a particular aspect of chemical and physical properties, or elaborating in finer detail the electronic structure of the elements.

REPORT ON THE CHEMISTRY WORKSHOP CONDUCTED AT PENNSYLVANIA STATE COLLEGE

(Abstract)

GERALD F. HUTCHINSON, S.J.

A report was presented on the procedures followed, topics treated, conclusions reached, practical projects to be initiated, advantages in general, and in particular to Ours, in attendance. The Analytical Chemistry Workshop proposes to collect data from as many schools as wish to participate, on the results obtained with various quantitative unknowns, in order to determine the uniformity of results obtained by various schools throughout the country, and also the conformity with so-called true values. The General Chemistry Workshop is making a collection of laboratory experiments and classroom demonstrations, not readily available in textbooks, but which members of the Workshop have found more than ordinarily useful.

METHODS OF DETERMINING THE DIPOLE MOMENT OF SUBSTANCES

(Abstract)

PAUL J. MCCARTHY, S.J.

A brief description was given of two important methods of determining the dipole moment of substances. The first involves the measurement of the dielectric constant of solutions, and the subsequent application of the Debye equation. Dielectric constants are usually determined by capacitance measurements using the capacitance bridge, the resonance, or the heterodyne beat method, the last named probably being the most common. Dipole moments of gaseous substances may also be directly determined by using a microwave spectrograph. The method is as yet limited in application, but yields results of high accuracy.

CHEMISTRY TEACHING AT BAGHDAD COLLEGE

(Abstract)

JOSEPH L. RYAN, S.J.

Students take chemistry in second and fourth years, and are examined in it in the general government examinations at the end of third and fifth years. As an immedate preparation for the last government examination, a review of chemistry is conducted in Arabic by a lay professor.

Experiments in second year are conducted by the teacher. In fourth year a two-hour period is given for experiments by the students themselves.

Students in fourth and fifth years can, as members of the Scientific Society, hear weekly lectures, and perform additional experiments.

The new Rice Memorial Science Building has a 1600 volume science library, a laboratory, preparation room and lecture classroom for each of the sciences; and other science facilities.

The chemistry teachers are Fr. Leo J. Guay, S.J., M.S. Holy Cross, Ph.D. Clark, and Fr. Joseph G. Fennell, S.J., M.S., Boston College, and two lay assistants.

CALIBRATION OF A LARGE VOLUMETRIC FLASK

(Abstract)

ALBERT F. MCGUINN, S.J.

A method for calibrating a two-liter volumetric flask is proposed, based upon the relationship $V \times N = V' \times N'$. Two standard solutions and a calibrated 100 ml pipet are used to establish the values of three terms in the formula and the fourth term is calculated as the volume of the flask.

THE EFFECTS OF THYROXIN ON NUCLEIC ACIDS DURING CELLULAR GROWTH

(Abstract)

MIGUEL M. VARELA, S.J.

The paper aims at proving the correlation existing between thyroxin administration and cell growth expressed in terms of nucleic acid content. After a brief description of the compound thyroxin the action of the thyroid gland itself is described in relation to growth and metabolism. Experimental results of thyroxin, the active component of the thyroid, are then presented to show the former's effect on the growth process in various animal species and under different conditions. This is followed by presenting the work of a team of French biochemists attempting to correlate nucleic acid values with thyroxin administration. The experiments of the European workers was reproduced at Fordham University and also extended to include other organs that would normally be affected during a period of growth.

The value of these experiments is mostly in the field of cancer research since it seems pretty well established today that any type of

growth, whether normal or neoplastic (as occurs in cancer) can be measured by the rise above normal of the nucleic acids present in the tissue cells. Whether this mode of attacking the cancer problem offers a method of arresting its development is still a subject of further investigations.

CARBON CYCLE IN NATURE

(Abstract)

BERNARD SCULLY, S.J.

The carbon cycle in nature is a gigantic and complex interconversion of carbon dioxide from air and ocean into starch of plants and marine organisms (and indirectly into animal carbohydrates) with simultaneous reconversion of starch back into carbon dioxide liberated into the atmosphere and the ocean.

Under God's loving direction, this enormous cycle always ensures that there will be an abundance of carbon dioxide "building blocks" for plant starch and consequently for animal tissue while at the same time an unsafe excess of stifling carbon dioxide is prevented.

In the earth's atmosphere the total CO_2 content is estimated at $2x10^{12}$ tons and in the oceans the CO_2 present as free dissolved compound and as H_2CO_3, (HCO_3), and (CO_3) is about $66x10^{12}$ tons. The annual CO_2 "output" into the atmosphere and the ocean is figured at $497x10^9$ tons. Of this total $200x10^9$ tons are formed by plant decay and $231x10^9$ tons come from the seas through conversion of (HCO_3), (CO_3) and liberation of dissolved CO_2.

The "turnover" of carbon dioxide is relatively slow. Of all the available carbon dioxide in the world (i.e. $68x10^{12}$ tons), only about 3/4 of one per cent (i.e. $497x10^9$ tons) is produced each year in nature.

The higher CO_2 tension of the atmosphere over the ocean (about 0.00030 atmospheres) forces some CO_2 into the oceans whose average CO_2 partial pressure is 0.00023 atmospheres on the surface. There is a very slow diffusion of surface CO_2 into the ocean depths.

The CO_2 absorbed from the air, after dissolving in the ocean, forms carbonates and bicarbonates. With decreasing basicity more $CaCO_3$ will be deposited until a pH of about 8 will be reached. This is the normal pH of sea-water. A greater concentration of CO_2 would increase the acidity of the sea. This would cause solution of the hitherto insoluble $CaCO_3$. It is most fortunate for the ocean shell-fish that God's care controls the acidity of the sea for a slight increase would dissolve away their limestone skeletons.

The perfect operation of the complex equilibrium of carbon dioxide and its complicated products, insuring pure air for man, starch for plants and animals is a beautiful proof of the all-seeing Providence of God.

Mathematics

AN INTRODUCTION TO FOURIER SERIES

(Abstract)

C. F. Koehler, S.J.

The purpose of the paper was to introduce Fourier Series in such a way as to reply to the following questions:

1. What assumptions are sufficient to establish the ordinary relationship between the Fourier expression and its coefficients?

2. What conditions are sufficient to assure that the sum of the series converges to the given function?

3. Conversely, what functions can be represented by the Series?

4. How is the interval of representation adjusted?

After noting the confusion found in the ordinary texts of Advanced Calculus, the following convergence theorem was proven.

Given: 1 $f(x)$ is in the set P
2 $f(x)$ is in the set D'
3 $f(x)$ is in the set C at $x = x_0$

Then: $$f(x_0) = \frac{Ao}{2} + \sum_{k=1}^{\infty} (A_k \cos kx + B_k \sin kx)$$

It was noted in the paper that condition 3 is too strict. For, $f(x)$ not in the set C can be defined at $x = x_0$ as long as conditions 1 and 2 are fulfilled.

FOUNDATIONS OF ELEMENTARY ALGEBRA AND CALCULUS

(Abstract)

Philippe A. Dionne, S.J.

Outside a formal system of logic, in giving to the notions of set and mapping an absolute meaning independent of any axiomatisation or generation, it is possible to obtain a complete characterization of the following number systems: natural numbers (N), integers (Z), rational numbers (Q), real numbers (R) and complex numbers (C). Each of these systems is respectively characterized by the following properties:

N satisfies the five Peano's Axioms,

Z is an integral domain in which the positive elements are well ordered, Q is the smallest ordered field,

R is a complete ordered field,

C is a field containing an element i such that $i^2 = -1$ and a proper subfield isomorphic to R such that for every z in C, there exists x, y in R with the property that $z = x + yi$.

The property of categoricalness is a specific character of the classical mathematical systems in opposition to the modern ones, like group theory and topological spaces. The multivalent theory of these modern mathematical systems is desirable, because it does not restrict to one system the applications of the abstract results already obtained. However, it is a source of comfort to know that the system at the foundation of all mathematics, the system N, is essentially unique.

DEVELOPMENT AND SCOPE OF TOPOLOGY

(Abstract)

JOHN J. MACDONNELL, S.J.

There are two main branches of topology: point-set (abstract space) topology; and combinatorial (algebraic) topology. This paper deals with the former.

Topology is a kind of geometry. Just as elementary geometry deals with the magnitudes (length, area, and angle) which remain invariant under the rigid motions; and projective geometry deals with concepts (point, line, incidence, and cross ratio) which are unchanged by projective transformations; too, topology deals with those properties of figures which persist even when the figures have been subjected to transformations so drastic that all their metric and projective properties are lost. For example, imagine an inner tube to be deflated. The resulting amorphous figure is a topological image of the original inflated inner tube.

In abstract axiomatic language a topological transformation (homeomorphism) is a rule of correspondence, F, between the points p of a space R and the points p′ of a space R′ (in symbols: F: $p \rightarrow p'$) which satisfies the following two conditions:

1) The correspondence is 1-1 (biunique). That is to each point p of R there corresponds exactly one point p′ of R′ and vice versa.

2) The correspondence is continuous in both directions (bicontinuous). That is, the function F mapping R onto R′ is continuous and the function F^{-1} mapping R′ onto R is continuous.

What is the structure of the space R upon which the transformation is made? Prescinding from this or that geometrical figure we take the more general concept of a set of points to define a topological space. We say a set R is a topological space if certain subsets of R have been distinguished and called open, and if:

1) *Every* union of open sets is an open set

2) Every *finite* intersection of open sets is an open set.

Very often the class of open sets is not given directly but by various auxiliary devices such as neighborhood systems, closure operators, or metrics.

Some of the properties which remain unchanged when a topological space is transformed homeomorphically are: the Jordan curve property; the genus of a surface; the Euler characteristic of a surface; the dimension of a figure; compactness; connectedness; and the property of being dense-in-itself.

CONGRUENCES

(Abstract)

JOHN W. GREEN, S.J.

A simple explanation of congruences was given in terms of the hours of the day. Two necessary and sufficient theorems concerning congruences were stated and then three applications of congruences were given.

SIMPLE EXAMPLES OF TOPOLOGICAL MAPPINGS

(Abstract)

CHARLES J. LEWIS, S.J.

Whereas congruent figures may be mapped one upon the other with corresponding congruent mapping of the whole space in which the figures are embedded, such is not the case with topological mappings. Intrinsic properties of topological configurations are those which remain invariant under homeomorphic or topological mappings, and which do not depend upon the space in which the configuration is embedded. For example, orientability is an intrinsic property of a topological figure; two-sidedness is not. Orientable surfaces can be embedded in three-dimensional (non-Euclidean) spaces so as to be one-sided.

The above distinctions were illustrated with sketches of the torus, Möbius band and Klein bottle. The projective plane was shown to be homeomorphic to the closed Möbius band.

COMPUTATION WITH APPROXIMATE NUMBERS

(Abstract)

JOSEPH A. PERSICH, S.J.

This paper discussed significant figures and the accuracy to be expected from computations involving numbers of varying precision. Rules were given for determining the accuracy of the results of addition, subtraction, multiplication and division of numbers with different significant figures.

Physics

SOME RESEARCH PROJECTS FOR JESUITS

Francis J. Heyden, S.J.

It has occurred to me during the past few years that the Association of Jesuit Scientists might add to its functions a committee that would coordinate and encourage certain problems of research in various fields. We meet once every year and talk about work which we are doing; but we never seem to get around to approaching a problem that might need cooperative effort of several workers from different fields. Hence, I am going to talk just from my own experiences, and the deductions which I shall give should be taken only as a suggestion. Perhaps I am all wrong.

First of all, we must agree that the different experimental sciences have developed to such a great extent in the past fifty years that no longer can anyone be completely informed or proficient in biology, chemistry, astronomy or physics. It is a common thing to hear that an outstanding mathematician is an expert in applied mathematics, but that he knows nothing about analysis. The fact is so commonly accepted that no one is ashamed to admit that there are certain sides to his field about which he knows very little.

Those of us who teach a cycle of courses, and I have four completely different ones to keep up with, feel at times the futility of just keeping our lecture notes up to date. In the middle of one course several articles will appear which definitely indicate that our notes in another course are going to need revision. It takes a lot of time and trouble just to note down the reference so that when the other course comes around the revision can be made. That is one of the headaches of a teacher in any field that lacks the crystallization of Hebrew grammar.

On the other hand I for one cannot go along with lecture material as a steady diet. I have a yen to do something that is extracurricular as far as students are concerned and to do experimenting even if it is only an attempt to duplicate something that has been done before. Following such an impulse and giving a certain degree of priority to it, I have found that there are a lot of projects which are not too difficult and which do not require too much time. I shall enumerate some of my findings later on, but before I do that, I would like to say just a few words more about the need for a coordinating committee which I mentioned previously.

Any research project that is selected must suit the interest of an individual. One does not look up an index, put his finger on an item and then after turning to the page decide to do that particular thing. A certain amount of study will awaken curiosity; but experience and detailed information about the feasibility of a project cannot always be found without a discouraging amount of reading and questioning. Very often a project just cannot be undertaken for want of equipment or assistance.

I do not see why the difficulties of getting advice and assistance on a research project cannot become a part of our organization. It must happen that two or more of us are interested in the same project, although one may be more expert in one phase of it than the other. One may be eager to do some experimenting in scientific photography, another in optics and a third in the analysis of the data which would result from a perfect combination of an optical system and expert photography. There is a good chance for teamwork which can lead to valuable results and the feeling of satisfaction that comes with success.

Now suppose that three men who are interested in the same project are stationed at Buffalo, Boston and Washington, and that the equipment is mainly in Boston. We have a problem in protocol or whatever you may wish to call it in order to have them carry on their project in Boston. This may be a big difficulty but I do not believe that it is an insurmountable one. Rectors will have to be convinced that their science departments will benefit if they will finance such a joint project.

As a matter of fact most research projects do not require that all of the equipment be located in one laboratory. While it is almost essential that all three should spend at least a few weeks together to get the observational data, the reduction work may be carried on in the three separate places during the year.

With regard to research projects I shall mention only one on which I have been working for the past three years. In the course of that time a lot of problems have arisen and with other jobs that I have on my hands I have not had a chance to follow up on all of them. Yet I think that they are interesting and worth while. Some of them have been entrusted to graduate students, but I have kept one project separate from the graduate students, and in the performance of this I have found most of my research problems.

Last year I described the large spectograph which has been installed in Georgetown Observatory with the combined help of the Bureau of Standards, the Naval Research Laboratory, the Army Map Service and the National Geographic Society. In the spring of this year the Office of Naval Research approved a project for us and gave us funds to finance the cost of photographic materials and some assistance for observing. We are commissioned to get to work on the solar spectrum for which at least two new photographic maps are badly needed.

This task was undertaken several years ago by the Allegheny observatory of the University of Pittsburgh and it was never brought to satisfactory completion. Finally in 1939 the job was given to Georgetown where the spectroscopists of the Bureau of Standards would have a chance to loan equipment which they could not send to Pittsburgh. The war stopped the project in its initial stages, and when I took it over in 1948, Dr. Kiess of the Bureau and I decided that we had better start all over again because the old seismic vault on the hill beside the observatory was too narrow for the spectograph. This took a lot of work because about 1000 cubic feet of granite piers had to be removed from the cellar room where the instrument is now placed.

Setting up an instrument with a ten foot collimator and a six inch concave grating with an eleven foot focal length almost makes the instrument an integral part of the building. I never realized what a job of leveling and adjusting lay ahead of me. I started taking plates with the help of a graduate student to whom I had given a small fellowship for the work as an assistant. Every time we thought that we had a nearly perfect plate, Dr. Kiess would always point out some features which showed that more adjustment was necessary before we would have the quality which he expected of the instrument. The winter passed and we hopefully planned for the summer with the advent of the funds from the ONR.

One of the projects which we had and on which a graduate student had been working during the year was the identification of the ghost lines which are peculiar to a diffraction grating. Our student never finished the work for the spring graduation because of a heart attack which has put off the completion of the thesis indefinitely. Along about that time Father Joseph Mulligan suggested that he might try to locate the ghost lines by using the mercury isotope (198) as a light source. He will tell you about his work during the summer at Georgetown, and while I hope it was profitable to him, I must make an admission here that he was the best perfectionist we have had around our spectograph since we started, and when he left last week, the instrument was in almost perfect adjustment and the plates of the solar spectrum were rolling off every day. We feel proud of them and Dr. Kiess feels that if we can keep up the quality we shall have an excellent map of the solar spectrum.

Now as we progress with this work, I can foresee several problems of research which might be of interest to others. Dr. Kiess has mentioned that he has at least six doctorate problems to be done with the spectograph. But apart from doctorate problems, there are various projects which are worth investigation by anyone who is interested. For example we have three different type microphotometers. We are not happy about the performance of anyone of them, although they are probably three of the best available for our purposes. One is a Fabry, the other is a Meggers and the third is a photoelectric which Father Mulligan rigged up this summer. Is any one interested in microphotometry? There is the problem of better standards for wavelengths which might be found in the very sharp line of the mercury isotope. There are a lot of very faint lines in the solar spectrum which the Bureau of Standards attributes to iron in the sun and which the spectroscopists at Mt. Wilson attribute to ghosts. There is the problem of reproducing the map of the solar spectrum for publication. I have no idea yet just how this can be done or how much it will cost. A few years ago we printed the photographs of the southern Milky Way which were taken in Brazil by Father McHugh and myself on the occasion of the eclipse expedition. It took a whole summer of experimenting before we were able to reproduce a set of negatives on which the stars images and interstellar clouds of dust had been itensified sufficiently well to make good prints on paper. We were very happy to hear that our work was rewarded by the comment of astronomers in every part of the world to which we sent the atlas that we had preserved the identity of individual stars. It was hard work and we wasted a lot of photographic material, but we achieved what we wanted. A similar project lies ahead for the reproduction of the spectrum.

If we can show that we can do it, I am sure, we shall get funds for the work from the Naval Research.

These are only some of the projects which I know about. Most of you know about others. It would be good to make them known. If a group could plan an attack on one of them, it would be possible to prepare a proposal and ask the National Science Foundation or some other interested organization for financial backing.

Such cooperation in research would also awaken keener interests in the younger Jesuits who are just coming into the fields of the sciences. Some of these because of the pressure and need for teachers may feel that they will never get a chance to make any progress in their field. In fact they may never really get interested. But if they could help out in some research work, they may get deeper in their field, find some special interest and carry it on to acquiring the academic degree which they need, and want.

But again I would like to point out that the Association of Jesuit Scientists should try to exert a guiding hand in coordinating and directing some, not all, research projects.

TOWARD AN EFFECTIVE TWENTIETH CENTURY COSMOLOGY

(Abstract)

JOSEPH T. CLARK, S.J.

The motivation for this study lies in the pardonable supposition, based upon a careful survey of currently adopted textbooks and class manuals, that there is in point of fact some room for genuine improve-

ment in the methodology, sequence, and content of the standard scholasticate cosmology course which at the present time frequently leaves the student with native philosophical aptitudes supercilious towards the sciences and the student with native scientific abilities unsympathetic towards philosophy. The objective of the essay is to suggest in concrete and feasible detail on the basis of a decade of experimental procedures a curricular program and corresponding syllabus, designed to give maximum results in the contemporary context to the greatest number of students at minimum costs of curricular revision or academic complexity. The materials at hand on which to work and build are the presently prescribed three standard courses in (1) cosmology itself and those in Scientific Questions from both (2) mathematics and (3) physics. The precise point of the suggestions proposed in the paper is to secure the most effective combination possible of courses (1), (2), and (3), conformably to two criteria taken conjointly: (a) the directives of the *Ratio studiorum superiorum,* especially 153-155, and (b) the inner logical demands of the respective sciences of mathematics, physics, and philosophy of inorganic nature *in se.* In effect it is here proposed that in some *one* scholastic year of the three year philosophy course (i) the first half of the first term be given over to the scientific questions course from mathematics, (ii) the second half of the first term be dedicated to the scientific questions from physics course, and (iii) the second full term of the same year be assigned to the course in cosmology. The special orientation here suggested for (i) is that it take as *the* basic scientific question from mathematics that cluster of foundational problems currently called *the philosophy of mathematics.* The special character here proposed for (ii) is that it choose as *the* fundamental scientific question from physics that collection of inquiries and results named in contemporary circles *the philosophy of science.* In each case the task in hand is *not* to discover *all* about some one or other branch of mathematics or physics (such as calculus or quantum physics), but rather to disclose to the perceptive student correctly and effectively just what it is in fact that the respective sciences of mathematics and of physics are all *about.* By contrast it then becomes clear in turn what course (iii) is all about. Detailed syllabi (which it is impossible here to summarize), and helpful reference and textbook materials for each course from (i) to (iii) are supplied in the paper. The essay closes with the expression of a solid hope, based on the blue-book evidences of student achievements to date, that such a program successfully produces Jesuit Scholastics who are *both* well-equipped in philosophy *and* intelligently sympathetic to the enterprises of mathematics and of physical science, and thus prepared to function as *effective* sources of influence in the mid-twentieth century world.

TRANSISTORS—THEIR OPERATION AND APPLICATION

(Abstract)

J. J. Ruddick, S.J.

In the five years since its invention the transistor has taken a position of considerable importance in the field of applied physics. An offspring of the rectifying point-contact diode, it performs many of the functions of electron tubes and may be defined as "an active bilateral semiconductor circuit element." For their operation, point-contact devices depend on the modulation of conductivity in the bulk semiconductor by injected carriers from a metal contact. Junction transistors can be explained in terms of rectifying barriers and the resultant distribution of potential.

One widespread use of transistors is in switching circuits, including of course those involved in computing machines. Other applications are found in audio and radio amplifiers and in oscillators of ranges up to 300 Mc.

ABSORPTION OF ULTRASONIC ENERGY IN LIQUIDS BY THE PULSE METHOD

(Abstract)

John A. Tobin, S.J.

The report on this work done at Boston College was divided into three sections: (1) The design and construction of the apparatus; (2) the measurement of the absorption coefficient in various liquids at different temperatures at a frequency of 30 mc.; (3) the measurement of the absorption coefficient at different temperatures and frequencies. The power supply oscillators and receiver were constructed from surplus radar parts. A tank was constructed with a temperature control from 0-100°C.

Pellam and Galt used this method in 1946. Rapuano then used the acoustical delay line and Pinkerton used the comparison pulse. We use the delay line and comparison pulse. A synchroscope sends out a trigger pulse that goes through two lines. In the delay line it is held up 5 to 100 microseconds, goes through a pulse forming network, pulsed oscillator, an attenuator, back to the receiver, and then to the synchroscope. The other line takes the pulse through a pulse forming network, pulse oscillator, and a matching network to the crystal. There it is changed to acoustical energy and goes through the liquid, is reflected back through the liquid to the crystal, and then changed to electromagnetic energy that goes to the receiver and the synchroscope. On the synchroscope you see the "main bang" that goes through directly, then the echo, and the comparison pulse may be moved so that it is near the echo. To make it the same size as the echo the

attenuator is changed and this reading gives the attenuation for the liquid path length by moving the reflector a known amount.

On plotting the absorption coefficient versus the temperature, a high degree of linearity was found for various liquids.

Contract Ord. 2569 from U. S. Office of Ordnance Research partly supports this work.

MODES OF VIBRATION OF A *ROTATING* STRING

(Abstract)

JOHN S. O'CONOR, S.J.

When a tightly stretched string of length L and density d is *rotating* with an angular velocity a, about its length axis X, analysis shows (Hildebrand, Advanced Calculus for Engineers, p. 202 sq.) that:

$$a_n = n\pi/L\sqrt{T/d}$$

where T is the tension in the string.

The discreet values of a_n are known as critical speeds. For the condition $O < a < \pi/L\sqrt{T/d}$ the only stable position of the string is one of undeformed configuration along the axis of rotation. For successive critical speeds; n = 1, 2, 3 etc. a new equilibrium form or deflection mode may exist. These additional modes correspond to the nodes and loops of the analogous case of the *vibrating* string.

As such a condition seemed intuitively unlikely to some of our students a demonstration was set up, using nylon cord and two rotators, synchronized with a strobotac.

The modes of vibration appeared as indicated in the analysis.

ULTRASONIC ABSORPTION IN WATER: HALL THEORY

(Abstract)

STANLEY J. BEZUSZKA, S.J.

The observed absorption of ultrasonic waves in liquids is far greater than the value derived from a theory based on shear viscosity or heat conduction processes. Hall found satisfactory agreement between theory and experiment for the case of water by assuming a structural relaxation phenomenon. During a compression, the water molecules are brought uniformly closer together and also rearranged or repacked more closely. Two structures are assumed: one is open and the other compact. The open structure of water is characterized as having a broken-down ice form where the long range order has disappeared, but considerable local order persists. The compact state is taken as that of closest packing (face centered cubic). Transition rates and activation energy values are derived and the plot of the

theoretical excess absorption vs. temperature agrees remarkably well over the range from 0 to 80 degrees centigrade with the experimental values of Fox, Rock and Smith.

However, while the agreement between Hall's theory and the experimental results is satisfactory for water, Sette found that the theory did not account for the excess absorption in ethyl alcohol. It may prove useful to reverse the direction of inquiry and use absorption data to evaluate the structural-molecular quantities involved in the relaxational or structural compressibility.

THE ASTROPHYSICS SYMPOSIUM AT THE UNIVERSITY OF MICHIGAN

(Abstract)

FREDERICK L. CANAVAN, S.J.

A brief report is given of the symposium in Astrophysics held at the University of Michigan from June 29th to July 24th this summer. The program and personnel are discussed and an evaluation made of the advantages to be obtained at such a meeting.

A "NEW" INTERPRETATION OF QUANTUM MECHANICS

(Abstract)

ROBERT O. BRENNAN

D. Bohm has recently revived in a slightly different form the "pilot wave" theory of de Broglie. The new "causal" interpretation of quantum mechanics rests on the introduction of a "quantum mechanical potential" derived from the solution of the Schroedinger equation. Some criticism of the new view was presented.

THE SPECTRUM OF MERCURY—198

(Abstract)

JOSEPH F. MULLIGAN, S.J.

The 5460.7532 A green line of mercury—198 seems destined to replace the red line of cadmium as the primary standard of wavelength. This even isotope of mercury has a spectrum without hyperfine structure, and can be excited under conditions such that Doppler broadening, self-reversal, and pressure effects are minimized. When excited by a high-frequency electrodeless discharge the mercury—198 tubes developed by Meggers at the Bureau of Standards are simple and convenient to use, and yield intensities superior to those obtained from a cadmium furnace.

At the Georgetown Observatory during the summer of 1953 tests were made on an original Rowland concave grating now being used in

the preparation of a new atlas of the solar spectrum. A mercury—198 tube, excited by the radiation from a magnetron tube at 3,000 megacycles (10 cm. wavelength), was used as a source. Its sharp, intense, well-spaced lines were ideal for studying the "ghost" lines of the grating. No Lyman ghosts were observed, and the Rowland ghosts observed had intensities of approximately 0.5% the intensities of the parent lines.

SCIENCE COLLOQUIUM—A PROGRESS REPORT

At the beginning of the 1952-3 school year, a Science Colloquium was organized at Weston College for the purpose of fostering and stimulating interest in the branches of the physical and mathematical sciences. The present paper is presented by way of a progress report to the American Association of Jesuit Scientists. It is written for the present meeting in Philadelphia in order that the members of the Association may be made aware of some small efforts at increasing interest among Jesuit Scholastics in the scientific apostolate of the Society. We hope that this brief enumeration of some of the works and projects of the past year will serve to acquaint you with the good that has been done by the gracious cooperation and generous support of several members of your Association. We would be especially grateful for any suggestions which the members of the AAJS may have for our future activities.

In addition to the Faculty members of Weston College and the Scholastics who are or have been engaged in the teaching or study of the natural sciences, membership has been extended to the Directors and members of the various science faculties of Jesuit Colleges and High Schools in the area.

Fr. Francis C. Buck was named by Fr. Rector to serve as Moderator; Mr. Martin F. McCarthy is the first Chairman and Mr. Richard D. Fahey is the first Secretary of the Science Colloquium. The initial plans called for a monthly meeting to be held on Sunday afternoon. We are indebted to Fr. Daniel Linehan for offering us facilities of the Lecture Hall of the Seismology Building for our Colloquia.

The format of the meetings is quite simple: a brief paper of introduction presented by one of the Philosophers, the main address given by the invited speaker and a period for questions. An informal discussion, with refreshments, marks the close of the session.

On Sunday, October 19, 1952, the first Science Colloquium was conducted. We were very happy to welcome several members from the science faculties of Holy Cross College and Boston College, together with a large number of Fathers, Theologians, and Philosophers from Weston. Rev. Fr. Rector delivered the Inaugural Address and discussed the pronouncements of the recent Holy Fathers and of Rev. Fr. General concerning the apostolic value of scientific studies in the work of the Society of Jesus. (Fr. Coleran's address is reprinted in The

Jesuit Science Bulletin, Vol. XXX, No. 2, pp. 59-63.) The topic for the first Colloquium was *The Geology of New England*. Mr. John E. Brooks gave a brief exposition of the role of the Society of Jesus in the development of the Earth Sciences, and introduced Mr. James W. Skehan; Mr. Skehan presented an illustrated lecture on the mountain-building processes which are responsible for the geological development and the present appearance of New England. (Mr. Skehan's talk has been reproduced in The Jesuit Science Bulletin, Vol. XXX, No. 3, pp. 82-88.)

Our November meeting presented a treatment of the *Role of Physics and Chemistry in Modern Biological Research* by Fr. Michael J. Walsh. Mr. Robert G. Doherty introduced Fr. Walsh and described *The Jesuit Biologist*.

In December, a Symposium on Evolution was held with three Fourth Year Fathers discussing the evidence from Anthropology (Fr. Frank Lynch), from Geology (Fr. John Devane), and from Biology (Fr. George Drury). Mr. Simon E. Smith introduced the speakers and defined the *status questionis*.

Fr. Daniel Linehan, Director of the Seismological Station of Boston College was the main speaker at the January meeting. He gave an illustrated lecture on *Seismology and its Applications to Engineering*. Mr. Joseph MacDonnell introduced this topic with a brief discussion of *The Work of the Society of Jesus in Seismology*.

In place of the regular February Colloquium the Science Colloquium presented the first Ahern-Quigley Lecture. This lecture, which will be presented annually for the members of the Weston Community and our invited guests, is dedicated to the memory of two outstanding Jesuit Scientists who were members of the Weston College Community, Fr. Michael J. Ahern and Fr. Thomas Quigley. (Cfr. Obituary Notices of Frs. Ahern and Quigley: The Jesuit Science Bulletin, Vol. XXV, No. 2, p. 40, 1947 for Fr. Quigley; Vol. XXIX, No. 2, p. 40, 1952 for Fr. Ahern.) The Ahern-Quigley Lecturer for 1953 was Fr. Francis J. Heyden, the Director of the Georgetown College Observatory, who spoke on: *Modern Research in Solar Eclipses*. Fr. Heyden's presentation was illustrated with the U. S. Navy Film of the Eclipse of February 25, 1952 at Khartoum. (Cfr. The Jesuit Science Bulletin, Vol. XXX, No. 2, p. 67, 1953.) In order to accommodate the large audience, the lecture was presented in the Weston College Auditorium.

On March 15, 1953, the final meeting of the Science Colloquium for the current academic year was held in the Lecture Hall of the Seismology Building. This session honored Fr. Henry M. Brock, our oldest member, who this year begins his fortieth year as a Jesuit teacher. Fr. John A. Tobin introduced Fr. Brock and spoke on *Motivation and the Science Student*. Fr. Brock, who knew nothing of the nature of the meeting in his honor, gave a most interesting lecture on *Astronomical Research by Jesuits*. At the conclusion of Fr.

Brock's address the Provincial of the New England Province, Very Rev. Fr. William E. FitzGerald addressed the members and congratulated Fr. Brock on his splendid work as a teacher of science. Fr. Provincial presented Fr. Brock with a Spiritual Bouquet prepared for the occasion by the members of the Science Colloquium. The festivities closed with the serving of refreshments which featured a special cake prepared by Bro. Edward Barthelmess and cut by our guest of honor.

In addition to the monthly meetings, the Science Colloquium sponsored the showing of several Science-Educational Films. Mr. Bernard Scully was Chairman of our Visual Aids Committee. We are very grateful to Fr. Louis Sullivan of the Weston College Faculty for his efforts in obtaining science films which were of special interest to our members: *Destination Moon* and *Kon Tiki*.

Abstracts of the lectures and discussions at the monthly meetings are published in COLLOQUIUM NOTES, a multi-lithed publication. This work is intended to provide our members with permanent copies of the proceedings. It does not propose to assume the status of a magazine or journal. All of Science Colloquium members are active or at least potential members of the American Association of Jesuit Scientists thereby reading and contributing to the Jesuit Science Bulletin, the official organ of the Association. The Science Colloquium at Weston is honored to consider itself a "younger brother" to the American Association of Jesuit Scientists and is pleased to make any of its published material available for reprinting in the Jesuit Science Bulletin.

It may be worthy of note to mention that we have received requests for additional copies of COLLOQUIUM NOTES from several of our College Religion and Philosophy Departments. We would like to acknowledge the invaluable aid of the following in assisting us with the publication of COLLOQUIUM NOTES: Rev. Fr. Rector, Rev. John V. O'Connor, Prefect of Studies at Weston, and Mr. Vincent Keliher, Bro. James Collins, Bro. Arthur Lopilato of the Weston College Press.

One of the outstanding features attending the inauguration of the Science Colloquium has been the generous support, by their encouragement and by their participation in our activities, of the Superiors of the Province and House, of the Faculty Members of Weston College, and of the members of the Science Departments at Boston College and Holy Cross College. It is a pleasure to thank them for the inspiring edification they have given us.

The Chairman-elect of the Science Colloquium for the coming year is Mr. James W. Skehan; the Secretary-elect, Mr. Simon E. Smith. Any suggestions for future activities, speakers, or topics for discussion at future Colloquia will be received with sincere gratitude. Monthly notices of forthcoming Colloquia will be mailed to any who would like to attend. A few bound copies of the first Volume of COLLOQUIUM

NOTES are available for House Libraries—*ad usum nostrorum tantum.*

In conclusion, we recommend the continued success of this little project to the prayers and Holy Sacrifices of the members of the American Association of Jesuit Scientists.

MARTIN F. MCCARTHY, CHAIRMAN
RICHARD D. FAHEY, SECRETARY

ERRATUM

Ruddick, "Semiconductors," *Bulletin,* **30**, 137 (May, 1953).

A hole due to the removal of an electron from near the top of the filled band of a semiconductor was stated to have a negative mass. This would be true if the hole formalism were applicable in a gravitational field. However, the notion of a hole is used in connection with electric and magnetic fields, where the formalism requires that the fictitious "particle" have not only positive charge but positive mass as well. The matter is briefly discussed in a letter of Shockley, *Phys. Rev.*, **88**, 953.

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BRev Book Review
OBIT Obituary

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