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of the  
National Science Convention

September 4th - 5th - 6th, 1940

*Loyola University, Chicago, Illinois*

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OCTOBER 1940

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Bulletin of American Association  
of Jesuit Scientists

EASTERN STATES DIVISION

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A. M. D. G.

*Contribution of*  
THE AMERICAN JESUITS IN SCIENCE  
*to the*

QUADRICENTENNIAL CELEBRATION  
of The Society of Jesus  
1540 — 1940

NATIONAL SCIENCE CONVENTION

Loyola University  
Chicago, Illinois

September 4th - 5th - 6th, 1940



GENERAL MEETINGS

OPENING SESSION LOYOLA ALUMNI GYMNASIUM  
Wednesday, September 4, at 3:00 P. M.

Address of Welcome Rev. Samuel K. Wilson, S.J.  
President of Loyola University

Reading of the Minutes by Secretary Rev. J. Emeran Kolkmeier, S.J.  
Brooklyn Preparatory

Appointment of Committees

Presidential Address Rev. Richard B. Schmitt, S.J.  
Loyola College, Baltimore

*Science and Philosophy*

*The Society of Jesus and the Sciences* Rev. Alphonse Schwitalla, S.J.  
Saint Louis University Medical School

GENERAL MEETING LOYOLA ALUMNI GYMNASIUM  
Wednesday, September 4, at 8:00 P. M.

Scholastic Principles and Modern Science Rev. Joseph P. Kelley, S.J.  
Weston College

Can Science be Humanized? Rev. Charles M. O'Hara, S.J.  
Saint Louis University

Contribution to Science by the Jesuits in the Philippine Islands  
Rev. William C. Repetti, S.J. (*By Proxy*)  
Manila Observatory



PUBLIC MEETING  
LOYOLA COMMUNITY THEATRE  
Friday, September 6, at 8:15 P. M.

- The History of American Jesuits in Science  
Rev. James B. Macelwane, S.J.  
Saint Louis University
- The Limitations of Physical Knowledge — Dr. Arthur E. Haas, Ph.D.  
University of Notre Dame  
University of Vienna, 1923-1936
- A Century of Astronomy: Georgetown University Observatory  
Rev. Thomas D. Barry, S.J.  
Georgetown University
- Alaskan Expeditions — Rev. Bernard Hubbard, S.J. (*By Proxy*)  
Santa Clara University

#### GEOLOGY - GEOPHYSICS SECTIONS

Thursday Morning Session—Cudahy Hall—Room 123

- Chairman ————— Rev. James B. Macelwane, S.J.
- The Geological History of the Rockies as Revealed at Canon City.  
Victor J. Blum, S.J. Saint Louis University
- The History of Upper Pleistocene Man.  
Conrad Bilgery, S.J. Regis College
- Submarine Canyons of the Atlantic Coast.  
Joseph S. Joliat, S.J. John Carroll University
- Correlation of Gulf Lows and Microseismic Storms at Spring Hill  
College Observatory.  
Anthony J. Westland, S.J. Spring Hill College
- Earthquakes in the West Indian Region.  
Daniel Linehan, S.J. Weston College
- The Free Pendulum O'Leary Clock of Georgetown University  
Observatory.  
James K. Connolly, S.J. Weston College and Georgetown Univ.
- The Sun of the Illustrious Alphonse X, King of Castile.  
Frederick W. Sohon, S.J. Georgetown University
- The Mechanico-Optical Seismograph of High Magnifications.  
Joseph S. Joliat, S.J. John Carroll University
- Geophysical Prospecting for Petroleum.  
James B. Macelwane, S.J. Saint Louis University
- Mapping of Geologic Structure in the New England Area by  
Seismic Methods  
Thomas J. Smith, S.J. Weston College

Head Waves.  
George J. Brunner, S.J. Saint Louis University  
Friday Morning Session—Cudahy Hall—Room 123

HISTORICAL SYMPOSIUM ON GEOPHYSICS AND GEOLOGY WITH  
EMPHASIS ON JESUIT CONTRIBUTIONS

The Society and the Geological Sciences.  
Michael J. Ahern, S.J. Weston College

Jesuit Contributions to Meteorology.  
Alphonse R. Schmitt, S.J. Loyola University (Chicago)

Terrestrial Magnetism.  
Victor C. Stechschulte, S.J. Xavier University

Jesuit Contributions to Our Knowledge of Sun Spots.  
John P. Delaney, S.J. Loyola College (Baltimore)

Map Making and the Society.  
James B. Macelwane, S.J. Saint Louis University

Jesuit Contributions to Our Knowledge of the Earth's Interior.  
J. Joseph Lynch, S.J. Fordham University

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BIOLOGY SECTION

Thursday and Friday—Morning and Afternoon Sessions

Cudahy Hall—Room 213

Chairman ..... Rev. Patrick H. Yancey, S.J.

Demonstrations of the Use of a Modified Graph Method in the  
Teaching of Embryology.  
Terence H. Ahearn, S.J. John Carroll University

Effect of Anterior Pituitary Aids in the Teaching of Comparative  
Anatomy.  
John A. Ryan, S.J. University of Detroit

The Calcareous Sacs of Anura.  
Charles J. Wideman, S.J. Loyola University (Chicago)

The Present Status of Electro-Encephalography.  
Joseph G. Keegan, S.J. More House, New Haven

Ancient Man.  
Joseph S. Didusch, S.J. Loyola College (Baltimore)

Experimental Adaptation of Paramecium to Sea-Water.  
John A. Frisch, S.J. Canisius College

The High School Biology Syllabus.  
James L. Harley, S.J. Washington College, D. C.

- Jesuit Biologists in the Old Society.  
Joseph P. Lynch, S.J. Fordham University
- Partial Restoration of Function after Destruction of Upper  
Motor Neurones.  
E. Clarence Shaffrey, S.J. St. Joseph's College
- Demonstration of Supplementary Aids in the Teaching of  
Comparative Anatomy.  
Terence H. Ahearn, S.J. John Carroll University
- The Genetics of *Habrobracon*.  
Patrick H. Yancey, S.J. Spring Hill College
- Photography in the Teaching of Biology.  
Francis A. Bautsch, S.J. Marquette University
- Philosophy of Biology.  
Raymond H. Reis, S.J. Saint Louis University
- Cross Section Anatomy of the Frog.  
Paul L. Carroll, S.J. Creighton University
- A Trimmer for Paraffin Blocks.  
Arthur A. Coniff, S.J. Georgetown University

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#### CHEMISTRY SECTION

Thursday and Friday—Morning and Afternoon Sessions—Room 114

Chairman ..... Rev. George Shiple, S.J.

- Ammunition and Artillery in Atomic Transmutations.  
Louis Keenoy, S.J. Regis College
- Some Results on Unknowns in Quantitative Analysis.  
Francis W. Power, S.J. Fordham University
- High Speed De-Icing.  
Francis Keenoy, S.J. Rockhurst College
- Three Micro Methods for Molecular Weight Determinations.  
Richard B. Schmitt, S.J. Loyola College (Baltimore)
- Quantitative Analysis by Spectroscopic Methods.  
George Tipton, S.J. Regis College
- A Further Study of the Organic Antimonials.  
Gerald R. Beezer, S.J. Seattle College
- A Comparison of Methods in the Determination of Chloramine.  
T. Joseph Brown, S.J. Canisius College

- Gram - Molecular - Volume Box.  
George Pickel, S.J. John Carroll University
- The Vitreous State of Matter.  
Joseph J. Sullivan, S.J. Holy Cross College.
- Molecules, X-Rays and the Continuum.  
George M. Tipton, S.J. Regis College
- The Function of Cultural Chemistry in the Jesuit College.  
Anthony G. Carroll, S.J. Boston College

MATHEMATICS SECTION

Thursday Afternoon Session—Cudahy Hall—Room 123

- Chairman ..... Rev. Bernard Hausman, S.J.
- Original Manuscripts of the Mathematical Works of  
Christopher Clavius.  
Edward C. Phillips, S.J. Georgetown University
- A Revaluation of Mathematical Probability.  
Leo J. Yeats, S.J. Gonzaga University
- A New Derivative of Euler's Formula.  
Aloysius F. Frumveller, S.J. University of Detroit
- Application of the Equation of LaPlace and Poisson.  
William J. Carney, S.J. Mount St. Michael's
- Infinity and Non-Euclidean Geometries.  
Conrad Bilgery, S.J. Regis College

Friday Afternoon Session—Cudahy Hall—Room 123

- Curves of the Fourth Harmonic of  $A_{C_n}$  with Respect to Conics.  
James E. Case, S.J. Saint Louis University
- A New Number Theory Function.  
William C. Doyle, S.J. Rockhurst College
- Sampling Tests on Small Sample Statistics.  
Francis W. Power, S.J. Fordham University.
- Recent Contributions to the n-body Problem.  
James F. Butler, S.J. Xavier University
- Early American Curricula and Text-books.  
John P. Smith, S.J. Georgetown University
- Deaths of Jesuits in Groups of Three.  
Joseph T. O'Callahan, S.J. Holy Cross College

## PHYSICS SECTION

Thursday Morning Session—Cudahy Hall—Room 224

- Chairman ..... Rev. John A. Tobin, S.J.
- Developments in Beta-Ray Spectroscopy.  
John S. O'Connor, S.J. Woodstock College
- The Continuum in Modern Science.  
Francis J. Altman, S.J. Mount St. Michael's
- Cosmic Ray Telescopes.  
John A. Tobin, S.J. Boston College
- The *Ars Magna Lucis et Umbrae* of Athanasius Kircher, S.J.  
Victor C. Stechschulte, S.J. Xavier University
- Refinements in Radio Receivers.  
Leo J. Vollmayer, S.J. John Carroll University
- Lake Tides in the Jesuit Relations.  
Alphonse R. Schmitt, S.J. Loyola University (Chicago)
- Physics in an Introductory Course.  
P. W. Froebes, S.J. Rockhurst College

Friday Morning Session—Cudahy Hall—Room 224

- The Kerr Cell and the Measurement of Exceedingly Short  
Time Intervals.  
Lawrence J. Monville, S.J. Saint Louis University
- Spectroscopy.  
Joseph F. Carroll, S.J. Marquette University
- The *Musurgia* of Athanasius Kircher, S.J.  
Joseph M. Kelley, S.J. Loyola High School (Baltimore)
- Some Leaves from the History of Atomic Physics.  
James I. Shannon, S.J. Saint Louis University
- A Washington Hobby Show and Science Exhibition.  
Herbert P. McNally, S.J. Gonzaga High School (Washington, D. C.)

THE AMERICAN ASSISTANCY  
OF THE SOCIETY OF JESUS

St. Andrew-on-Hudson  
Poughkeepsie, N. Y.

Office of the Assistant

University of San Francisco  
San Francisco, California  
August 29th, 1940

Rev. Richard B. Schmitt, S.J.  
President,  
National Jesuit Science Convention  
Loyola University  
Chicago, Illinois

My dear Father Schmitt:—

P.C.

It is truly a pleasure for me to congratulate Your Reverence on having enlisted such a distinguished group of speakers and drawn up so imposing a list of subjects for discussion at the National Science Convention. Would that I could give myself the great pleasure of attending your meetings!

Your program is proof that the Jesuits of today are as deeply interested in genuine scientific progress and as proficient in advancing it as were the famous Jesuit men of science of old! The heart of our beloved Father General, distressed as he is with the dangers and distress which afflict the Society in Europe and the Missions, will find much solace in learning of this Convention with its splendid contribution to the Society's 400th birthday celebration. Your program should go far in bringing to the attention of the learned world our own American Jesuit activities and progress in the various fields of Science.

My cordial greetings and prayerful best wishes to the Officers and Members of the Association!

Devotedly yours in the Sacred Heart,

ZACHEUS J. MAHER, S.J.

# PRESIDENTIAL ADDRESS

REV. RICHARD B. SCHMITT, S. J.

We meet on this extraordinary occasion in commemoration of an extraordinary event. Our purpose is: That we may recall the successful endeavors and accomplishments of the Past—and this for our inspiration; to examine our numerous efforts of the present, particularly in scientific education; to prepare for improvements in the immediate future, wherever they may be needed; to correlate philosophy and science in the light of unchangeable principles and the newly discovered facts of today. This is indeed a huge task and we sincerely hope that these days of this, the first National Science Convention, will be eminently profitable.

For a brief moment, we recall the tireless efforts and successes of a few of our predecessors: Fathers Hagen, Clavius, Ricci, Wassman, Kircher, Riccoli, Secchi, Faura, Rigge, Scheiner, Algue, Sestini and many others of happy memory. We recognize too, the glorious work of the present generation, of those who are emulating these former champions in the laboratory and in the observatory all over the world. We salute these men, Our Brothers in Science, and we wish them continued success.

With your kind indulgence, may I offer a thought for your consideration at the opening of our convention, namely the necessity and importance of science for the proper viewpoint of philosophy. The most evident fact of our times, is the fact of a changing world; this is so true in every phase of endeavor. At this moment, we are interested in the viewpoint of the new discoveries and progress of scientific facts, as compared with the immutable solid principles of the past that cannot be altered. The Sciences are distinct in their proximate contents, as well as in the proper viewpoint. Furthermore, there is a borderland where scientist and philosopher meet to study the intrinsic constitution of matter, as biologist and psychologist both investigate the nature of life. Yet, in addition to this, it must be said that since all truth is unitary in its principle source and its ultimate end, every investigator of truth must have a basic concept of its constituent elements, if he is to harmonize his findings with those of collaborators in other fields. The scientist is interested primarily in the facts of his experience and the intimate laws which govern them. The philosopher has a broader and deeper field. With the whole cosmos as his laboratory, he tries to interpret its very nature to all men. While in no sense neglecting evident facts, he is most of all concerned with those universal and

necessary principles, which express the fundamental relationships between these facts. Thus the fact-finding of science and the metaphysical reasoning of philosophy are the twin pillars of that temple of truth, which we call Human Knowledge. Segregate physical fact from metaphysical principle and at once you are on the high-road to one of two equal absurdities: crass materialism or fanciful pantheism.

This is evident from the principle as recently enunciated by the renowned mathematician Einstein: What cannot be observed, does not exist (for the scientist). Furthermore he asks: If a thing cannot be observed, why is it necessary to assume its existence? (*Atomic Physics*, Physics Staff, Univ. of Pittsburg, page 259).

The human intellect is gifted with a peculiar native insight into the nature and essence of things. It really discerns, at least in the broad outlines of the world of experience, the *Universal* and the *Necessary* in the individual, as well as the contingent.

From this existing being of experience, the human intellect abstracts a single *Note of Being* and contemplating it thus in this timeless and spaceless and non-dimensional form of abstraction, sees by the very evidence of *Being As Such* that it is unalterably opposed to its own contradiction, i.e., *Non-Being*, which is the most fundamental of the metaphysical principles: *The Principle of Contradiction*.

In addition to the principle of contradiction, there are other metaphysical principles of equal importance to an adequate philosophy of knowledge. Briefly they are: *The Principle of Sufficient Reason*; *The Principle of Efficient Causality*; and *the Principle of Final Causality*.

To the materialist this sounds like unintelligible mysticism, but to the Catholic professor, scientist or philosopher, it is the veriest deliverance of reason, synthesizing fact with metaphysical principle, as well as with faith in Divine revelation.

We cannot admit the denial of the *Primal Fact*; though not first in the order of human knowledge, God is the first in the order of reality. Lest we forget, there are two other facts, or sets of facts, of vast importance. They are: the existence of this real universe, composed of substance and accidents, and the existence of human minds endowed with a native capacity to know with certitude. This complexus of *Three Fundamental Facts* and *The Four Metaphysical Principles* form the network of all knowledge, whether philosophical or scientific. Into this mould must fit every demonstrable truth in the order of nature. Every hypothesis, theory or supposed law of thought or action, which does not ultimately regard these fundamental truths, is thereby false. Man's knowledge may and does progress within the circumference of this sphere, but by the nature of *Truth* and *Reality* itself, can neither transcend nor contravene it.

The very distinction that is made between probability and certitude implies that we know what each is, and that we have a criterion



to separate them. And so, the commonly accepted principle of all materialistic schools of thought, that we can never say the last word about anything, is patently false.

Undoubtedly science and philosophy must and does make progress in this human march of time. No one age knows all the possible facts of experience nor all the underlying laws. Much of what is now regarded as demonstrated in various fields of inquiry may at some later date prove only imperfectly known, and to be in need of recasting in the light of further experimental data. *But*, it still unequivocally remains that there are certain fundamental truths that are timeless and spaceless, and so are independent of human progress or regress in thought.

The absence of a true philosophy among scientists is responsible for the warped development in human progress. When science is regarded as a panacea for all human ills, when it is made a substitute for religion, when it is heralded as the great torch to illuminate the human mind darkened by superstition and legend, then it can only distort human development. The Jesuit training which furnishes the Jesuit with a clear objective in all fields of learning limits the scope of scientific investigation. He should know the precise value of experimentation with matter in terms of its contribution to the total sum of human knowledge. He should realize that there are many sources of truth, that philosophical and theological investigations yield certain demonstrated conclusions which scientific investigation can never obtain. He distinguishes methods from content and understands the great usefulness of the techniques discovered and developed in the field of natural science. His background should not permit him to stick his head in the sand, like an ostrich and ignore scientific data, nor will it allow him to become so circumscribed by his intense application to scientific methods, that he fails to see its relation to other fields of knowledge. He is a specialist recognizing the part of his specialty in the great whole. He knows the goal of his journey in terms of life's value, before he undertakes to map out its course in a limited area.

He will not confuse the by-paths with the main road. His habitual attitude is: what is science's contribution to the whole life of man? His eagerness and zeal in the cause of science is not one of exclusion of the other realms of knowledge, but one of distinction.

The Jesuit Scientist is not the Jesuit philosopher or literateur or theologian. He is not dissipating his energy by research in other fields, but he recognizes that there are philosophers, literateurs and theologians, who contribute by valid methods of research distinct from his own. He recognizes that he shall never see God in the test-tube, but we shall find data there and evidence which through reasoning definitely demonstrates His existence. It is precisely his acknowledgement of the value of metaphysical study, that distinguishes him

from the scientists who recognize no methods as valid, but the positivistic. The Jesuit, therefore, is a friend of science who by his background, by his true conception of its scope, has done and will do more lasting things in winning the permanent esteem of mankind for the achievement and value of science, than those who make it the monster that sooner or later will destroy its Creator. This is not an eulogy of any present day work in science. We are not so foolish to think that we have reached perfection; on the contrary, we are aware of our defects and for this very purpose we have our scientific organizations to discuss how we can improve our system of education.

We realize too, that there are philosophers who approach the solution of the problems of the universe without adequate preparation in science, and some who fail to admit that such preparation is necessary to be able to grasp the problems, but we shall not isolate ourselves in the opposite camp and grieve in our tent like Achilles.

As members of the Society of Jesus, with the tradition of four hundred years of experience, with an apostolic spirit that faces and seeks to overcome all difficulties in the propagation of the *Truth*, we dedicate ourselves to a definite part of that apostolate, namely the apostolate of science.



# GENERAL SESSIONS

## SCHOLASTIC PRINCIPLES AND MODERN SCIENCE

(Abstract)

JOSEPH P. KELLY, S.J.

All branches of knowledge that pretend to be systems, stand in need of a basic metaphysics, for metaphysics is the natural language of the human mind. The followers of Scholastic Philosophy are seeking a Philosophy for Science.

The philosopher and the scientist are treating the same beings, the same subject matter, analyzing many of the same aspects of these same objects, the main difference lying in the manner of dealing with them. The Scholastic Philosophers established many *principles* which are valid today in the interpretation of problems on the borderline of Science and Philosophy.

The Scientist of today is looking for the meaning of the world and of the bodies that compose it. Before he can proceed with his modern, scientific method, he must first make the same judgments about these bodies, judgments based on normal sense-experience, which the Scholastics made concerning the existence and the nature of these same physical entities.

The broader principles based on the nature of beings, on the relation of properties and activities to the nature, are still valid principles and in these we can find the means of approaching a solution of many of those problems which lie in the borderland between Science and Philosophy.

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## THE HISTORY OF AMERICAN JESUITS IN SCIENCE

(Abstract)

JAMES B MACELWANE, S.J.

The secret of the scientific achievements of members of the Society of Jesus is to be found, in part at least, in the generous abandon with which the true Jesuit, talented and well trained, throws himself into the lifework assigned him in the name of his Divine Captain and Leader, Jesus Christ in Whose service he would be ashamed to give less than the best. The Jesuit missionary, for example, like Kino, Marquette, and the Fathers who surveyed and mapped Lake Superior, struggling through the wilderness, loads himself with astronomical and surveying instruments because there is no map and a map is needed for all those who will come after him. The American

Jesuit astronomers like Grassi, Curley, Secchi, Sestini, Hagen, the Rigges labored worthily to prepare themselves, spent the night hours in painstaking observation in their observatories and the day attending to their spiritual duties in order to distinguish themselves in the service of their Divine Master. The American Jesuit meteorologists like Stuntebeck, Odenbach and Ricard and the seismologists Odenbach, Tondorf, Rousseau, Blain and Goesse, to mention none of those that are still living, gave the best they knew A.M.D.G. and it was much.

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## THE LIMITATIONS OF PHYSICAL KNOWLEDGE

(Abstract)

ARTHUR E. HAAS

Since the behavior of single ultimate particles cannot be described in the language of physics, the modern scientist finds a lower limit to his exploration if he tries to penetrate into distances as small as the dimensions of the ultimate particles of which matter is composed. Due to the so-called red-shift of light rays he also faces an upper limit when he wants to penetrate into distances which are about ten times greater than the largest distances which can be reached by modern telescopes.

Other limitations result from the fact that explanations by a physicist cannot mean more than establishments of connections between observable phenomena. Therefore, questions must remain which the physicist cannot possibly answer. The physicist cannot solve the fundamental problems of philosophy, but he can discover relations between them and open new viewpoints for their consideration.

Many questions which are often raised appear meaningless from the standpoint of physics because we cannot base our system of physics on the hypothesis of ultimate particles without individuality and then apply the laws of this system of physics to the ultimate particles themselves. For this reason also the much discussed question of elementary causality is beyond the limitations of physical knowledge, and can only be the topic of philosophical research and philosophical truth.

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## A CENTURY OF ASTRONOMY—THE GEORGETOWN UNIVERSITY OBSERVATORY

(Abstract)

REV. THOMAS D. BARRY, S.J.

The history of one of the oldest Observatories in the United States was traced from the initial steps taken towards its establishment in 1841 to the present time.

The series of Jesuit Directors beginning with Fr. James Curley, who held that post for over forty years, is given with some indica-

tion of the progress made under each of them, special attention however being paid to the accomplishment of those who had the greatest influence upon its activities—Fr. James Curley, its founder (1843-1886); Fr. John G. Hagen (1888-1906); and Fr. Paul A. McNally (1928 onwards).

In its early years the Observatory was devoted chiefly to the use of the students. Under Fr. Hagen its main activity was systematic observation of variable stars along with the necessary fixed comparison stars in the field of each variable; this resulted in the publication of the famous *Atlas Stellarum Variabilium*. In recent years photographic observation of Eros and of variable stars along with visual observation of occultations formed the main portion of the active routine, whilst participation in Solar Eclipse Expeditions of 1932, 1936, 1937 and the approaching one of October, 1940 marks a new development which has brought a knowledge of Georgetown and its Observatory to a much larger public than any of its previous activities.

Among other Jesuit scientists who were at one time or other connected with the Observatory mention is made of the work of Fr. Francesco de Vico, Fr. Angelo Secchi, Fr. Benedict Sestini, Fr. Jose Algue, Fr. William F. Rigge, Fr. George A. Fargis (who developed the Georgetown Photochronograph) and Fr. John T. Hedrick. To these and others Georgetown owes the gradual development of its Observatory throughout its first century of progress now nearing completion.



# GEOLOGY—GEO-PHYSICS

## THE HISTORY OF UPPER PLEISTOCENE MAN

(Abstract)

CONRAD BILGERY, S.J.

This paper treats of the Upper Pleistocene of the Denver Basin with special reference to Pleistocene Man. A gravel pit at 48th and Acoma (Denver) and other deposits were studied and some idea of the rate at which the river beds were filled up was gained. The conclusions drawn from a study of these regional deposits were not in agreement with those of Emmons, Cross and Eldridge (U.S. Geol. Survey, 1896) and the U.S. Geol. Survey at Washington was notified.

Discovery of various kinds of loess in the region is announced and the kinds described. Special emphasis is laid on the finds in the excavation of the mammoth bed at Dent, where, all in all, bones of at least 14 individual mammoths were uncovered, but not the slightest evidence of the presence of man.

The Pre Chellean stone culture of the Denver basin is discussed, and a number of artifacts discovered at various points are enumerated, described and catalogued. The fact that in the Denver Basin there is a Prechellean stone culture gives new meaning to the many surface finds that range from the Chellean to the Upper Paleolithic types and were formerly considered to be Indian.

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## THE SUBMARINE CANYONS OFF THE ATLANTIC COAST

(Abstract)

J. S. JOLIAT, S.J.

After a brief description of submarine canyons, their location and geographical distribution, the paper outlines the recently proposed submarine spring sapping hypothesis, which is based on the well-known fact that fresh water springs well up from the sea bottom off many coasts. They are known to be due to artesian pressure in underlying porous strata which should normally lead out to the margin of the continental shelf. Why should there not be springs gushing forth there? This seems highly probable because the stratigraphic relations are favorable, were even more favorable in the past. If so, why should not these springs sapping the outcropping layers produce canyons as on land? Why should not the expulsion of immense quantities of connate waters from these sources add to this sapping effect? In reply

we might say the sapping power of the artesian waters will be exhausted long before reaching the outcrop, and that connate waters are chemically a filtrate and have no capacity for solution. However, increase of pressure and temperature further down might sufficiently restore sapping power to accomplish a huge amount of solution at the seaward outcroppings in the course of 60,000,000 years since they were laid down in cretaceous period.

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## CORRELATION OF GULF LOWS AND MICROSEISMIC STORMS AT SPRING HILL COLLEGE OBSERVATORY

(Abstract)

A. J. WESTLAND, S.J.

A study of the disturbances recorded on the horizontal Weichert at Spring Hill College (located on Mobile Bay) during a 17 month period, April 1939—Aug. 1940, seems to corroborate the theory that microseisms are caused by cyclonic storms over the ocean. Thirty-two seismograms showed microseisms of sufficient size to permit measurement of periods and amplitudes though no effort was made to determine actual ground movement. The average period was three seconds and the maximum double amplitude for one storm reached 4.0 mm.

Data from the Weather Bureau at New Orleans, Mobile and Jacksonville, for the corresponding days showed well defined lows in the Gulf in all save five cases for which the ship reports were insufficient to permit drawing a detailed map of the region.

Three of these storms were exhaustively investigated, Jan. 23-24, Aug. 5-6, Aug. 10-11, with positive results in each case.

The Wiechert records of Jan. 22, 23, 24, 1940 indicated the existence of a storm and examination of the seismograms revealed microseisms of approximately equal amplitudes on both the N-S and E-W components. Noon of the 23rd showed double amplitudes of 2.7 mm. N-S, and 1.8 mm. E-W.; 7.30 pm., 0.7 mm. N-S and 1.6 mm. E-W. By midnight Jan. 23 the amplitude on the N-S was scarcely determinable, that on the E-W was 1.5 mm.; at noon of the 24 small microseisms were still being recorded on both components. A series of maps prepared from the original ship reports loaned by the Weather Bureau at Washington, D. C., showed a well developed low which moved during this period in a northeast direction from Lat. 23.5 N Long. 95 W. to 36.5 N. 68.5 W.

The seismogram of Aug. 5th 6.30 a.m. showed measurable microseisms on both components; there was a maximum of 1.3 mm. on the N-S and of 0.5 mm. on the E-W. By midnight the amplitude on the latter component had increased to 1.2 mm., continued about the same on

the N-S, dying out around 6 p.m. Aug. 7. According to data from the Weather Bureau at New Orleans a tropical storm was centered almost due south of Mobile, moving in a west-northwest direction that struck inland Aug. 7 doing much damage. On Aug. 11 a very similar storm centered a little north of east of Mobile moved inland near Charleston. Microseisms were recorded Aug. 10-11 with a maximum about noon on the latter day though the amplitude did not exceed 0.7 mm.

The results of these elementary studies seem to point furthermore to a relation between the amplitude on the two components and the geographical position of the low.

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## EARTHQUAKES IN THE WEST INDIAN REGION

(Abstract)

DANIEL LINEHAN, S.J.

The importance of studies of seismic disturbances in the West Indies is emphasized in the present paper. It is believed that a solution of many of the earthquakes now occurring there will enhance our knowledge of the tectonic structure in that area, especially about the so-called Negative-Gravity-Anomaly Arc that surrounds the islands.

Attention is called to the number of quakes taking place at present and which are recorded on short period instruments of very high magnification only. The need of more instruments of this type is stressed, especially to study a supposedly new phase recorded in the northern azimuth from this location.

The quakes, as recorded in the north-eastern section of the United States, are of normal depth, very short period and of slight intensity. Only one has shown definite surface waves in over a period of five years recording, numbering some seventy-five quakes in all, and all have demonstrated the existence of one and sometimes two unknown phases.

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## THE O'LEARY FREE PENDULUM CLOCK

(Abstract)

JAMES K. CONNOLLY, S.J.

A description of a two pendulum clock system consisting of a free pendulum time keeper and a slave pendulum for controlling supply of energy to the free pendulum. The advantage of this free pendulum clock consists in exact and constant synchronization of free and slave pendula. This synchronization is effected by a synchronizing switch and a pair of synchronizing solenoids associated with the slave pendulum.



MAPPING OF GEOLOGIC STRUCTURE  
IN THE NEW ENGLAND AREA BY SEISMIC METHODS

(Abstract)

THOMAS J. SMITH, S.J.

During the past two years the seismic method of petroleum exploration has been applied to various problems in subsurface geologic structure by the Department of Seismology at Weston College. In the Bellows Falls Quadrangle of New Hampshire depths to contact were measured, using the reflection method, at several points on a line across a body of Bethlehem gneiss, believed from surface indications to exist as a basin-like structure resting on Littleton schist. This survey showed, incidentally, that the increase in velocity of waves travelling parallel to the strike of foliation over those at right angles to the strike is some 70%. A similar investigation was carried out near Lebanon, New Hampshire, in the case of a body of Bethlehem gneiss resting on a Quarzitic conglomerate. The maximum depths encountered in this work has been from 3,000 to 4,000 ft. Both projects were undertaken at the request of the Department of Geology of Harvard University and Harvard University defrayed the expenses. As part of a general project to map the depths of the glacial deposit over New England, and especially to trace the pre-glacial courses of the Charles and Merrimac Rivers, depth determinations were carried out at Cochituate, Massachusetts, and the pre-glacial bed of the Charles located at that point. In the course of a survey to locate deep gravel deposits for the Water Department of the Town of Weston, now nearing completion, further data was obtained when the refraction sounding method gave a depth of 257 ft. to bed rock as compared with a depth of from 90 to a hundred feet over the adjacent area. Some very good results were obtained in this work by the use of shallow reflections. In connection with projected tunneling operations through rock beneath the City of Boston, by the Metropolitan District Water Commission, seismic depth determinations were made to locate desirable positions for test holes. A survey of the Connecticut Valley in Connecticut, jointly with Yale University has been mapped out for the coming year.

Grateful acknowledgment is here made to the officials and engineers of the Humble Oil Company of Texas both for the gift of the entire apparatus and for advice and assistance in overcoming difficulties in operation and interpretation.

## GEOPHYSICAL PROSPECTING FOR PETROLEUM

(Abstract)

JAMES B. MACELWANE, S.J.

The geophysical methods that have been applied to the discovery and exploration of structures favorable to the accumulation of petroleum are very numerous. But the most important of these methods may be brought under four heads.

*Seismic prospecting* is the application of some form of multiple seismograph of extremely high sensitivity to the detection of elastic waves generated by a charge of dynamite in order to map the underground structure.

*Magnetic prospecting* consists in the detection and measurement by means of some form of magnetometer, of local anomalies in the magnetic field of the earth and their interpretation in terms of the crustal structure.

*Gravity prospecting* depends on the differences in density between successive layers of the earth's crust and the consequent local gravitational anomalies that are produced at the earth's surface by a dome, or fold, or fault, or even by sedimentational lensing and overlap. The torsion balance and the gravimeter are the instruments that have been used.

*Electrical prospecting* includes a large variety of methods of concluding to structure from differences in specific resistivity and the observed distortion of fields or changes of apparent resistance.

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## JESUIT CONTRIBUTIONS TO METEOROLOGY

(Abstract)

ALPHONSE R. SCHMITT, S.J.

An account of what Jesuits, from the beginning of the Society of Jesus to the present, have added to the science of meteorology through routine observations and original investigations. Meteorology as a science dates only from the end of the 18th century, organized gathering of weather data from about the middle of the 19th century.

Jesuits are shown to have been early in the field and, in some parts of the world, the first pioneers. The study and forecasting of hurricanes and typhoons at the observatories of Belen, Manila, Zi-Ka-Wei and Tananarive is a distinctively Jesuit contribution. Before the present European war began there were 21 Jesuit meteorological observatories in 15 different countries. Brief descriptions and historical accounts of each of these are given.

## THE SOCIETY AND THE GEOLOGICAL SCIENCES

(Abstract)

MICHAEL J. AHERN, S. J.

Geology is the biological and physical history of the earth. As a separate science its development began about the end of the 18th century, during which time the society was suppressed. However the observations of the earth phenomena, the records of which laid the foundations of geology, began with the Greek philosophers. Aristotle made many observations on the work of rivers, of the ocean of volcanoes. The Scholastic philosophers, notably Albertus Magnus, and Aquinas, were not blind to the occurrence of earth phenomena to which there are numerous references in their writings. It is now recognized that medievalists were surprisingly alert in their observations of nature. Of course our early Jesuits knew and discussed these facts. Athanasius Kircher made, according to the historian of geology, Von Zittel, the "first attempt to describe the earth from a physical standpoint." He made valuable contributions to volcanology, seismology, mining geology, earth temperatures beneath the surface, and made some of the first attempts to describe land-forms according to their mode of origin, thus becoming a pioneer in physiography.

Jesuit missionaries in all parts of the world have made valuable observations in all the sciences, the while they carried on their classic explorations in various lands. Of interest, particularly to American Jesuits were the mineralogical and physiographic observations of Jesuits in New France. They noted the occurrence of silver and coal mines in Acadia; they were the first white men to examine and report on the salt mines and salt springs in central New York, Illinois, and Kentucky, Quebec and Anticosti. They noted the rich copper deposits around Lake Superior. Especially noteworthy were their descriptions of the earthquake of February 5, 1663 in New France. More than sixty pages of volumes 57 and 58 of the English edition of the "Relations" are devoted to this quake. Hobbs says of their descriptions: "There are few existing accounts which more clearly and picturesquely set forth the phenomena accompanying a truly great earthquake."

During two centuries our Spanish fathers explored the Philippines and at the time of the American occupation the researches of these Fathers formed the best extant accounts not merely of the geology and the geography, but of all the mineral and vegetable wealth of the Islands.

There are in Sourmervogel several hundred references to works by Ours in Cosmology, Meterology, Natural History, Cosmography; in most of these geological phenomena are described.

Jesuits in the United States have made seismology—to use the words of an eminent American geologist—"practically a Jesuit science."

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THE SUN OF THE ILLUSTRIOUS ALPHONSE X,  
KING OF CASTILE

(Abstract)

FREDERICK W. SOHON, S.J.

An examination is made of the astronomical tables in use in the days of the early explorers of this continent, with special reference to the tables of Ptolemy as reformed under Alphonse X by astronomers gathered together by him in Toledo.

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JESUIT CONTRIBUTIONS TO OUR KNOWLEDGE  
OF SUNSPOTS

(Abstract)

JOHN P. DELANEY, S.J.

Probably more than in any other field of science, Jesuit scholars have contributed brilliantly and continuously through the years to the advancement of the science of the sun. From the scholarly researches of Father Christopher Schreiner, who announced his discovery of sunspots several months earlier than Galileo's first mention of them down to the amazingly detailed investigations of Father Angelo Secchi with his newly invented spectroheliograph, Jesuit scientists covered the field as to the growth and decay of the spots, the sidereal and synodic period of the sun, the constitution of the sun as a gaseous body, and meanwhile preserved invaluable records and maps of the spots for use of present and future scientists.

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MAP MAKING AND THE SOCIETY

(Abstract)

JAMES B. MACELWANE, S.J.

Examples are given of the activity of Jesuits in the field of geodesy. Many Jesuit missionaries were expert cartographers and produced excellent maps. Voyages of exploration were often undertaken. Triangulation, leveling, precision, base-line measurements, taking of precise astronomical positions, etc. were applied to the mapping of several areas in Europe.

## TERRESTRIAL MAGNETISM

(Abstract)

V. C. STECHSCHULTE, S.J.

This paper sketched the outstanding problems in terrestrial magnetism, the existence and configuration of the earth's field as known and how such a field could arise, the secular variation of the field both in intensity and direction, the periodic (solar-diurnal and lunar-diurnal) variations, and the irregular variations of magnetic storms, and briefly indicated suggested theories.

Among Jesuit workers or writers in the field were mentioned Fathers L. Garzoni, Cabeus, Kircher, de la Charme, Lana-Terzi, Bosovich, Sarrabat, Secchi, Rodes, Beraud, de Moidrey, Fenyi. Reference was also made to the Observatories at Stonyhurst, Manila, Tortosa (Ebro), Loh-Ka-Pang (Zi-Ka-Wei), Tananarive (Madagascar), Belen (Havana).

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## A MECHANICO-OPTICAL SEISMOGRAPH OF A HIGH MAGNIFICATION

(Abstract)

J. S. JOLIAT, S.J.

This instrument, as its name suggests is so designed as to dispense with the need of a galvanometer. Two mechanical levers are so connected to a rigid frame and to one another to give a magnification of about 500, and the long arm of the second lever is so connected to the short arm of an optical lever as to raise this magnification to  $500 \times 120 = 600000$  or even more. To reduce friction the mechanical levers are attached to the frame and to one another by pieces of very thin metal, and the concave mirror from which the optical lever is obtained turns on a vertical wire of extreme thinness. This mirror is aluminized on the front face which very effectively eliminates all "ghost" spots. The damping mechanism on the vertical component consists of a perforated disk at the end of a vertical rod attached to the large lever, the disk being immersed in thick oil; on the horizontal, the disk is a disk of copper netting likewise suspended in oil.

# BIOLOGY

## DEMONSTRATION OF THE USE OF A MODIFIED GRAPH METHOD IN THE TEACHING OF EMBRYOLOGY

(Abstract)

TERENCE H. AHEARN, S.J.

The recording of serial sections by means of graphs presents many advantages over the drawing of selected sections through a series. The latter method is of course very convenient for the professor; a definite section can be drawn, labels, and perhaps the drawing itself, lifted from the text, the exercise handed in at a specified time, a grade assigned, and the topic closed. But the convenience purchased is deadly. Enthusiasm is killed, personal initiative is undeveloped, and the satisfaction of the professor in the progress of the student is wanting.

Last year, due to drastic simplifications and the minimizing of the technique of charting, the students really got into the swing of the method. They not only developed a sense of the three dimensional relations of the particular series under consideration, but when, at the end of the course, they instituted a comparative study of the graphs, they were able to appreciate the existence of problems of development.

Before going into the details of the application of the method to the series of 24, 33, 48, and 72 hour chicks, let me say parenthetically that the charting is only one of the devices used to revitalize the study. The incubator is started as soon as the students are ready for the 24 hour chick. Provision is made for the simultaneous study of the living chick and the stained whole mount.

Another slight incidental help is the use of plastic stings in colors. The diagrams of Patten are reproduced by means of these. Students keep a supply on the desk at all times. It is a matter of a few moments for them to demonstrate the formation of the extraembryonic membranes.

The greatest help was afforded by the study of the photographs of the entire serial. Drill in the use of the photographs has been the key to the rapid and intelligent grasp of the difficult problem of interpreting serial sections. The photographs can be made in any laboratory with photographic accessories; I will be glad to have the details of lens distance, exposure, paper, developer, etc. sent to you if you are tempted to try this.

Fleeting tantalizing glimpses of the complexity of the growth problem can be proffered, the existence of growth differentials, the

intermittent periods of intensive histological differentiation, the relation of extrinsic and intrinsic factors to the expansive drive that eventually, in spite of accidental and intentional interference, results in the organism that morphologically and physiologically is adapted for its role. These I maintain can be hinted at to force the student to cease thinking of the organism in the rigid static terms derived from the application of this method. The method offers a sound morphological basis for the discussion and appreciation of the fascinating field of experimental embryology and its philosophical implications.

With the help of the plastic stings and the photographs the actual application of the method to the study of the 24, 48 and 72 hour chick serials, was explained.

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### THE CALCAREOUS SACS OF ANURA

(Abstract)

CHAS. J. WIDEMAN, S.J.

After leaving the inner ear the endolymphatic duct of Anura crosses above the brain, and continues down the vertebral canal beside the spinal cord, sending diverticula through the inter-vertebral foramina on either side of the spinal column. These diverticula end in blind processes, the so-called calcareous or stone sacs.

The sac fluid is decidedly crystalline in structure.

Histologically the sacs seem to be fibrous membranes, composed of slightly modified dense areolar tissue.

The otoliths of the inner anural ear and the crystals found in the sac fluid seem to be identical in structure.

Relative to function, it is suggested that the calcareous sacs may be otolith reservoirs, or constitute otolith organs of secretion.

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### THE PRESENT STATUS OF ELECTROENCEPHALOGRAPHY

(Abstract)

JOSEPH G. KEEGAN, S.J.

This was a survey report of the general trend of research on the brain rhythms or cortical potentials, since Hans Berger's 1929 paper, which vindicated the feasibility of recording via electrodes placed externally on the head surface. After a brief account of the standard apparatus employed for the detection, amplification and recording of the cortical rhythmic potentials, emphasis was given to the theoretical implications, especially with reference to the basic psycho-physiological problem, the question of neural correlates of psychological activity.

There followed an account of the known wave "types" and the

range of their occurrence, with remarks on individual differences and the ontogenetic development of the "typical" rhythms. The discussion of deviations in sleep, hypnosis, epilepsy and schizophrenia was chiefly intended to point out the main directions thus far taken by the psychologist's interest in the cortical potentials. Apart from well-grounded hopes for their clinical value in epilepsy and in the localization of cerebral lesions, other applications in psychopathology are as yet in a preliminary stage of development. With respect to intelligence level and personality traits there is nothing conclusive to report, since correlational studies have yielded negligible results.

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## ANCIENT MAN

(Abstract)

JOSEPH S. DIDUSCH, S.J.

Two types of primitive man, *Sinanthropus pekinensis* (the Peking Man) and *Pithecanthropus erectus* (the Trinil or Java Man) were considered. The first fossil skull of the Peking Man was discovered in a cave near Chou Kou Tien, 37 miles south-west of Peking, in 1929. Since then fragments have been found representing approximately 40 individuals, including 9 fairly well preserved skulls and some teeth and jaw-bones, but no other skeletal parts except a clavicle, one cervical vertebra, a nearly complete femur and a few pieces of other leg bones. The last three of the nine skulls were found in two days, in November, 1936. From this material, Mrs. Lucile Swan, an American sculptress, under the direction of Dr. Franz Weidenreich, of the Cenozoic Research Laboratory, National Geological Survey of China, reconstructed the skull and made a restoration of the head of what is known as the Peking Woman. "Since practically all bones of the skull are available, with the exception of the zygomatic arch, the restoration was made merely by adapting the size of the single parts derived from several individuals of different sexes from the same location. The features and hair were modelled directly on a plaster cast of the skull, the thickness of the soft parts being determined from measurements made on female heads of different present-day races recorded by various authors". (Weidenreich). And all we have is another brain-creature, produced in the name of science.

Large quantities of other bones were found in the cave. Most of these belong to extinct mammalian species, but the bones of the Silka Deer, the Roebuck and the Big-horned Sheep, forms still extant in China, were also found.

According to de Chardin, the primitive characteristics of Peking Man, viz., the shape of the teeth, the prominent orbital ridges and the elongated and very low brain-case, represent the lowest



anatomical stage so far discovered in human ancestry. But the shape of the lower jaw, the cranial capacity, ranging from 900 cc. to 1220 cc., and his ability to make implements, many of which have been found in the cave, and to build a fire, abundant charcoal and ashes have also been found, place him in the category of the human species.

Four fossil skulls of *Pithecanthropus erectus* have been unearthed near Trinil, Java, in the last half century. The first was discovered in August, 1891, by Dr. Eugene Dubois, then a Dutch health officer. It is small, low and extremely flat, with heavy protruding eye-brow ridges. Along with the skull he found a femur which in all respects resembles the thigh-bone of a modern man. Dubois named this primitive species *Pithecanthropus erectus* because he considered it a connecting-link between the apes and man. Later on (1924), he was of the opinion that the skull was not human and did not represent a transition between any of the man-like apes and the human type. Finally, in 1937, he labeled *Pithecanthropus* a giant gibbon and maintained that both man and *Pithecanthropus* descended from a common primitive ancestor which resembled the gibbon more than any of the great apes. It is generally believed that Java Skull, Number 1, is human.

Java Skull, Number II, was discovered by Dr. R. von Koenigswald, of Bandoeng, Java, in August, 1936. It is almost identical with the Dubois skull-cap, but more complete. The third molar is very large and shows no trace of the reduction commonly found in human molars. On the other hand, the socket of the eye-tooth is small and not ape-like. The crown of the molars is more wrinkled than in man, but not so much as in Peking Man. The position of the ears and the articulation of the jaw with the skull are the same as in human crania. The skull is classified as human.

Java Skull, Number III, was found in 1938 and is apparently a fragment of a juvenile skull. The cranium has a pronounced longitudinal crest, as in *Sinanthropus*.

The latest and most important discovery in Java was made in January of last year. The remains consist of three-quarters of a brain-case, including the base, and fragments of an upper and lower jaw. There is a large cleft which extends through both cap and base and, besides, the skull and jaw-bones have been crushed. This is the largest of the Trinil skulls and is thought to represent a male, while the Dubois and von Koenigswald skulls are believed to be those of females. The two jaw-bones are correspondingly large and the upper jaw projects further beyond the face than in any other of the fossil remains. The molar teeth are large, but the canines are relatively small and are separated from the incisors by a wide gap or diastema. The skull is regarded as human.

Up to the present, anthropological science, with its prehistoric fossils and all its speculations, has taught us nothing with regard to the origin of man.

## PARTIAL RESTORATION OF FUNCTION AFTER DESTRUCTION OF UPPER MOTOR NEURONS

(Abstract)

CLARENCE E. SHAFFREY, S.J.

After a short consideration of the external and internal configuration of the cerebrum, and a review of the paths of motor impulses from the precentral gyrus to the multipolar cells of the anterior gray column of the spinal cord, the characteristics of the several types of motor neuron paralysees were outlined and compared.

The lower motor neuron paralysis, due to injury to or destruction of the multipolar cells of the anterior horn of the cord shows a flaccid paralysis, abolished reflexes, marked muscular atrophy, reaction of degeneration, and the irregular contractures.

The upper motor neuron paralysees may be due to a destruction of what is termed the pyramidal motor area located in the precentral gyrus, or to injury to what is called the premotor area, located anterior to the pyramidal area.

If the lesion is in the pyramidal motor area there is a flaccid paralysis, with a depression of the reflexes at first but later they become exaggerated and Babinski's reflex and Chaddock's are present; there is a marked muscular atrophy and a transient depression of the electrical reactions, with some flexion in the lower limbs and variable contractures in the upper limbs.

Where the lesion does not affect the pyramidal motor area, but is confined to the premotor area, there is seen a spastic paralysis, a great increase in the reflexes, no muscular atrophy and no change in the electrical reactions. The lower limbs are extended while the upper ones are flexed. There is great disturbance of skilled movements.

These differentiating characteristics of the two types of upper motor neuron paralysees have been determined by series of experiments on the chimpanzee by Fulton and his associates.

In a case of cerebral hemorrhage there is almost always an involvement of both the pyramidal and premotor areas, and hence it has been impossible clinically to determine the differences between the two types of paralysis, but by excision of one area without injury to the other it has been possible to distinguish one syndrome from the other.

In the removal of the motor area, there is a paralysis of the opposite side of the body, but in about a week there is a return of motor power, and there is no loss of memory for skilled movements, but if the premotor area is destroyed skilled movements will be permanently impaired although voluntary motor power returns simultaneously in all parts of the extremity and the spasticity of the muscles as well as

the vasomotor disturbances and the phenomenon of forced grasping seen in this type gradually disappear. But if a lesion is made in the premotor area of the opposite hemisphere, those symptoms reappear, indicating that there is a bilateral representation of each side of the body in each hemisphere.

Hence extending from the premotor area we have fibres passing down on the same side, ipsilateral fibres, which are able to take up the function of the fibres of the opposite side. If only a small portion of the premotor area of one side is left, volitional movements are still possible in all four extremities, even though the opposite hemisphere may be completely removed. It is becoming more evident daily that the participation of these ipsilateral fibres in functional restitution of function is direct, even in man.

Gardner has described the case of a man who was able to walk with a cane several years after the removal of one cerebral hemisphere.

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## THE GENETICS OF HABROBRACON

(Abstract)

PATRICK H. YANCY, S.J.

This form is a small wasp parasitic on the larva of the meal moth, *Ephestia*. The wild type has black eyes, antennae, legs and wings and a honey-yellow body with a pattern of black. It has been chosen for research work in genetics by several workers, especially by P. W. and A. R. Whiting. Some features that make it preferable to other forms are, first, because being parthenogenetic, recessive traits will show up in the first generation. Second it is easy to raise and has a life cycle of only ten days. The main objection to it is the smallness and larger number of chromosomes (10-20) than *Drosophila*.

Fifty mutations at separate loci have been listed. Twenty-seven of these have been located in eight linkage groups. The principal ones are in body and eye color. There are three body colors: honey, lemon and black and two combinations of these, lemon-honey and lemon-honey-black. There are eight eye colors in four independently segregating loci: Orange (light ocelli, dahlia, orange, ivory); White (white, carrot); Cantaloup; and Maroon.

A new mutation, Spread Wing, in which the wings stand out from the body, was found in the summer of 1938 among the  $F_2$  of X-rayed females.

Some three hundred gynandromorphs or sex mosaics with some male and some female characteristics have also been observed. Usually the head is of one sex and the genitalia of the other. Generally the sexual behavior is governed by the type of head.

## A HIGH SCHOOL BIOLOGY SYLLABUS

(Abstract)

JAMES L. HARLEY, S.J.

The original syllabus for the biology course in the high schools of the Maryland-New York Province, was drawn up by the Reverend Joseph Didusch, S.J., and published in 1923. This outline was used very successfully. It embodied a practical course in general biology, giving a comprehensive view of botany, zoology and human physiology, yet adapted to the needs and capabilities of the modern high school student. While very comprehensive in scope, it did *not* burden itself with the treatment of COLLEGE SUBJECTS such as genetics, anthropology, ecology, evolution, embryology, etc., etc.

The revised edition of the biology syllabus was published in September, 1938. The general outline and contents were retained. The principal changes might be summed up as follows:

- a. A rearrangement of the material within the individual chapters. A certain uniformity of treatment was achieved by dividing each chapter (e. g. in botany) into four parts, viz. kinds, structure, function and use to man. An examination of the syllabus will reveal the orderly divisions of the chapters.
- b. A detailed list of suggested demonstrations and a practical outline of prescribed laboratory work.
- c. A bibliography which includes a list of reference books for the teacher and a supplementary reading list for the student.
- d. A list of Catholic biologists.

Copies of the syllabus may be obtained upon application to: Reverend Michael A. Clark, S.J., Inifada, Mahasset, N. Y.

As the revised syllabus has been published in mimeographed form, we have allowed for necessary or helpful additions or subtractions. Comments, suggestions, criticisms, etc., especially from teachers of high school biology, may be sent to: Reverend James L. Harley, S.J., Gonzaga High School, 19 Eye St., N.W., Washington, D.C.

## PHILOSOPHY OF BIOLOGY

(Abstract)

RAYMOND H. REIS, S.J.

The primary object of the biological sciences is living bodies. The reality which is apprehended in living matter consequent upon any biologic investigation is not exhaustive since what is known is apprehended only by proximate causes. Its intelligible content is necessarily circumscribed by what the senses grasp in mobile and corruptible living matter. Philosophy, however, must advance the explanation or explanations that are most remote from the senses, i. e., the ultimate causes.

The biologic sciences bear witness to the fact that living nature is

knowable and that they know it in an essentially unsatisfying way. Biological experimentation looks for completion not as regards its formal object which accurately limits its sphere of activity, but in regard to the very term in which it issues. The philosophy of biology has for its object being possessing the perfection of life, being in the profound mystery of becoming a living substance, being successfully postponing its own dissolution into a less honorable condition. The philosophy of biology aims at the essence, the intelligible nature in living being, at that which is the ultimate reason why the phenomena of generation, morphogenesis, adaptation, regeneration, etc. are capable of being expressed in terms of physical units.

Scholastic philosophers as a group have been content to remain outside the system of scientific research—to the detriment both of the natural sciences and philosophy. The biologist can never divorce himself from an honorable submission to metaphysical principles nor can the philosopher imagine that he need not keep abreast of the ever increasing mass of scientific discoveries. By bringing the constantly growing content of the phenomenal living universe sensibly perceived into contact with philosophic first principles there results not a form of knowledge that is uncertain and which of necessity cleaves to the sensible, but a mode of intelligibility which unerringly points the way to Knowledge itself from whom all living reality has its *raison d'être*.

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## CROSS SECTION ANATOMY OF THE FROG

(Abstract)

PAUL L. CARROLL, S.J.

The frog is a very popular animal in the courses of general biology, zoology, embryology, histology and general physiology. It serves to illustrate very well some of the fundamental problems of structure and function. It is especially valuable for the dissection of the various organic systems, such as the digestive, circulatory and nervous systems. A student may dissect all of the systems separately, but fail to see the relationship between them. This relationship may be readily demonstrated by means of cross sections made at various levels through the body and through the limbs.

Cross sections are best prepared from a large male and female *Rana catesbiana*. After the animal is killed with ether or gas, it should be embalmed through one of the large arteries or the conus arteriosus and then injected with one of the rubberoid preparations now so popular. The specimen should be very firm and solid throughout, even to the cavities of the brain, interior of the kidneys, ovaries, etc. A weak acid may be added to the embalming fluid if decalcification is desired, however, it is not necessary to soften the bones in order to get a good cross section of them.

The specimen should be allowed to harden but not to become dry before the sections are cut.

With a thin sharp butcher knife the body can be sliced into sections about one inch thick; the limbs can be readily cut in the same way; sections of the head are a little more difficult to make. The sections should be numbered in their proper order and mounted singly or together in some suitable glass container. They may be dehydrated and stored in gelatin or one of the oils.

Each section can be studied until the relationship of all the systems is well known; the section should be compared with the gross dissection the student has made. Thus the student has the benefit of cross section anatomy without the use of the more expensive mammalian preparations.

### A TRIMMER FOR PARAFFIN BLOCKS

(Abstract)

ARTHUR A. CONIFF, S.J.

Two results are most desirable for good microtone sectioning. First is to have the sides of the paraffin block absolutely parallel for a straight ribbon and secondly to trim the block as closely as possible to the imbedded material where as many as possible serial sections are desired on the slide. Hand trimming is frequently a hit and miss method for either of these results.

The following is a description of a paraffin trimmer that was built by the Physics Department at Georgetown for Biology. The instrument consists of a cast iron T-shaped base. The vertical piece has two built up steel rails to form a V groove in which is securely fitted a sliding piece to insure shatter-free cutting. Topping the sliding piece the block holder is swiveled thus allowing undercutting of the paraffin blocks when desired. The front end of the block holder is movable and is machined to turn exactly  $90^\circ$ . When inserted and fixed by a thumb screw the paraffin block may then be moved forward against two parallel stainless steel knives. After two sides are thus cut parallel, the movable part is turned  $90^\circ$  and the other two sides of the paraffin block are similarly cut parallel and at right angles to the first cut, thus insuring a perfectly straight ribbon. The most satisfactory edge of the knife for cutting paraffin was found to be  $15^\circ$ . The knife was likewise mounted to the movable carriage at an angle of  $15^\circ$ . The carriages are moved by two large head screws which allow rapid movement and are grooved to the base with the same accuracy as the block holder to guarantee rigidity and smooth adjustment. Selection of material and designing looked to troubled free operation. Thus the rails are adjustable and all moving parts are steel against bronze. For convenience of preliminary trimming the block holder is provided with an extra hole and thumb screw for vertical mounting. Chromium plating and a finish of baked leatherette completed the construction.

## THE ADAPTION OF PARAMECIUM TO SEA WATER

(Abstract)

JOHN A. FRISCH, S.J.

In 5% sea water hay infusions (salinity of sea water=30.3) in which the concentration of sea water is gradually increased by evaporation, both *Paramecium caudatum* and *Paramecium multimicromicteatum* gradually die out. The concentration of sea water in which the last individual dies varies in different cultures from 33 to 52%. As the concentration of sea water increases the viscosity of the cytoplasm assumes a brownish-yellow color. The length, width, and the volume of the individuals decrease progressively with increasing salt concentration and many of the individuals become flattened. The addition of food in the form of ripe nutrient medium of the same sea water concentration to the cultures results in an increase in size and volume of the individuals and restores their normal shape. This indicates that the morphological changes are not due to the hypertonicity of the medium, but to a shortage of food. The rate of fission increases in sea water cultures until a concentrate of approximately 6% is reached; after that it decreases and may be inhibited for 1 to 6 days. Addition of food results in an increase of the rate of fission and less inhibition.

The average rate of pulsation of the contractile vacuoles and the average rate of formation of the food vacuoles are lower in sea water cultures than in fresh water cultures, but the average rate of pulsation is usually directly related to the average rate of feeding as is the case in fresh water cultures; there is no direct relation between these rates and the concentration of sea water. The addition of ripe nutrient medium to the cultures results in an increase in the rate of feeding and the rate of pulsation.

The size of the contractile vacuoles and of the food vacuoles decreases in sea water cultures. The fusion of the ampullar vacuoles to form the contractile vacuole, and the formation of the food vacuole are delayed and often inhibited in the higher sea water concentrations. This is due to a physico-chemical effect of the sea water on the cytoplasm of the individual and accounts for the decrease in the rate of pulsation of the contractile vacuoles in the rate of formation of the food vacuoles. The inability of *Paramecium* to adapt itself to sea water is partly due to a shortage of food in the sea water cultures and partly to the lethal changes produced by the salts of the sea water in the cytoplasm and the organelles of *Paramecium*.

## JESUIT BIOLOGISTS OF THE OLD SOCIETY

(Abstract)

JOSEPH P. LYNCH, S.J.

The period 1540 to 1773 is an interesting one not only for the general history of Biology but decidedly for the number of biological writers in the Society of Jesus. Up to 1600 there was little scientific Biology. Botany and Zoology were important as parts of medicine, particularly Pharmacy. Botany was more developed than Zoology due to the discovery of new pharmacals among the tropical flora of America and Africa. Human Anatomy, though, was cultivated intensely in Italy, but there only.

During the 1500's the Society of Jesus had some biological writers. The most outstanding was Father Benoit Pereyra, who was born in 1534 near Valencia, Spain. At 18 he entered the Society. He taught in Rome and died there in 1610. Fr. Pereyra taught Rhetoric, Philosophy, Scripture, and Theology. He was a prolific author "de omni re scibili."

The 17th century was one of tremendous advance. The microscope was invented. Scientific societies were founded. Great discoveries were made, and even a scientific journal was started, the "Journal des Scavans." Plant anatomy, entology, human anatomy, neurology, human anatomy, all were developed. Among the great names of the century are Harvey, Malpighi, Leuwenhoeck, Swammerdam, Wallis, Kepler, Descartes, and great Jesuit writers such as Frs. Athanasius Kircher, Honore Fabri, Gaspar Schott, Rene Rapin, Szent-Ivany, Buonanni, and Brother G. J. Camel.

The 18th Century developed the accomplishments inherited from the 17th. Until well into the 18th century scientists communicated their discoveries to one another by letter writing. The scientific societies were slow in starting journals. Collections of scientific correspondence are still extant, the greatest being those of Mersenne, Peiresc Collins, Wallis, Huygens, Boyle, Torricelli, Pascal, Newton, Leibnitz, Hooke, and our own Fr. Athanasius Kircher. Fr. Kircher's correspondence amounts to 114 volumes of MS.

During the life of the Old Society there were over three hundred Biological authors. The outstanding twenty of these were: 16th century, Frs. Pereyra, Lessius, Roberti and Castrillo. 17th century, Frs. Kircher, Lippey, Fabri, Schott, Rapin, Szent-Ivany, Buonanni, and Brother Camel. 18th century, Frs. Falkner, Loureiro, Egel, Cabral, Mittenpacher, Schrank, Daetzel, and Brother Clavera.



# CHEMISTRY

## MOLECULES, X-RAYS, AND THE CONTINUUM

(Abstract)

GEORGE M. TIPTON, S.J.

The argument concerning the one and the many has long been a philosophical problem. It recurs today in the question as to whether many of the smaller particles of matter are *una per se*, or whether they be but *aggregates* of still smaller particles.

Scientific investigations of the Braggs and of others have yielded information which seems to indicate that crystals are made up of definitely arranged ions of the constituent substances; this seems to argue that they are aggregates. Father Hoenen, S.J., on the other hand, and some other philosophers seem to hold that beyond doubt the crystal is an *unum per se*. Of these two incompatible opinions, which is correct?

By consideration of a simple bar magnet, we find that there is a "quid substantiale" which is really distinct from the accidents. We may also observe that the magnet has a two-fold extension; that is, it has a set of "*actual dimensions*" which any child might determine, and it has also another extension determined by the boundaries of its *field of force*. Ordinarily speaking, we would say that the "matter" was limited to the "actual dimensions", but it is evident that the *field of force*, since it definitely is not spiritual, must be considered as "matter". (A new English word to signify "matter" when used in this philosophical sense as opposed to "spirit" would go far toward eliminating the confusion which arises when it is mistaken for the scientific concept of "matter" as opposed to "energy".)

From the above we find that the magnetic field of force constitutes a *real material continuum*. Obviously then, it is most reasonable to hold that the *substance* of the magnet, the "quid substantiale", must be coextensive not just with the "actual dimensions", but rather is coextensive with that larger continuum, the *field of force*. Analogically, might not the same be applied to the crystal? Since even scientists admit that a field of force exists between the ions which make up the crystal, is it not most logical to conclude that the crystal is truly a *material continuum*. Once this is admitted, there can be no difficulty for the scientists which will hinder them from agreeing with Father Hoenen. At least from this viewpoint, there is no repugnance in considering a crystal as a real "*unum per se*."

## THE VITREOUS STATE

(Abstract)

JOSEPH J. SULLIVAN, S.J.

Some physicists divide the states of matter into anisotropic and isotropic, that is, crystalline and amorphous. The former would comprise solid crystals; the latter gases, liquids and glasses. Thus Tammann, *States of Aggregation*, 1925, and Luyet (following Tammann) *passim* in *Biodynamica*.

If a gas is cooled slowly, it passes through a transition point called the boiling point to become a liquid. If a liquid is cooled slowly it passes through the transition temperature called the freezing point to become a solid crystal. Crystalline, it will then remain down to absolute zero. How then is the glassy or vitreous state acquired? Remembering that glass is amorphous, an amorphous solid, it can be seen that a gas or a liquid must be frozen (rather cooled) at an extremely fast rate to obviate the alignment of atoms (or molecules) into a crystal lattice. The helter-skelter abandon of the gas or liquid state must be maintained in the vitreous state. So, if a gas or liquid is cooled so rapidly that the molecules cannot form crystal patterns, a glass is formed and this state will obtain down to absolute zero, also. Here is an instance where a liquid is chilled so fast that it cannot freeze (crystallize).

As the temperature rises, however, a glass may act in either of two ways. If the temperature gradient is rapid (extremely rapid), the glass changes from an amorphous solid to a liquid. If the temperature rise is slow, then at a temperature some distance below the normal freezing point, the glass devitrifies, that is changes from an amorphous solid to a crystalline solid. And as the temperature rises further, the crystalline solid melts at the freezing point.

From work thus far done, it would appear that most substances can occur in the vitreous state. The silicates have been the glasses of historic note. However, today there are numerous organic glasses, many of commercial value.

Thermodynamically, the vitreous state is less stable than the crystalline. But at low temperature, that is below the devitrification range, many glasses appear to have endured as such from distant geologic time. And there is no evidence of any transition.

Laboratory and household glass, maintained at terrestrial temperatures (around 20° C.) appear to remain unchanged indefinitely, that is, if they undergo no chemical change. What appears to be surface devitrification is, in many instances, a surface transformation into silica.

SOME RESULTS ON ANALYZED SAMPLES  
IN QUANTITATIVE ANALYSIS

(Abstract)

FRANCIS W. POWER, S.J.

Many teachers of quantitative analysis purchase their unknowns from one of the dealers who specialize in preparing and supplying such analysed samples. Occasionally a good student will report consistently a value quite different from that given by the dealer, and in such a case it is only fair that the professor should himself run the student's sample. When this is done it often happens that the student is right.

This situation has arisen often enough in the author's laboratory to warrant running several of these unknowns repeatedly. Few of the dealers run enough determinations to enable one to evaluate their precision expressed as a standard deviation; however, if enough of the unknowns are run it is possible to operate on the differences between the dealer's figures and those of the professor and thus get a sort of precision measure which is better than nothing. In this connection it may be found also that the final difference is not zero as one would hope it might be.

Following are listed some such figures,

Sample	Number of paired analyses	Difference	Stand. deviation in P. P. 1000
Sol. chloride	18	zero	7.9
Arsenic	18	9.0	11.7
Soda ash	15	1.5	2.9
Pyrolusite	10	6.4	5.5

A few figures are available to show the actual standard deviations obtained by repeated analyses of pure or homogeneous compounds.

Sample	Number of individual analyses	Stand. deviation in P. P. 1000
Pure $\text{Na}_2\text{CO}_3$ (author)	10	2.0
same (by a student)	10	1.4
same (by a student)	10	3.5
B. of S. iron ore 27 b (author)	15	3.3
same (by a student)	10	3.7
same (by an experienced analyst)	10	3.0
Dealer's unknown iron ore (author)	13	4.0
same (by an experienced analyst)	10	1.7

It is evident that if the checks obtained by experienced analysts on simple determinations are taken into consideration, the performance

of beginning students in quantitative analysis may be viewed with a more tolerant eye. Also, it is clear that a professor who takes a dealer's figures as if they were atomic weights and marks his students accordingly is either very naive or badly overworked.

In order to get any further with this general question it will be necessary to perform many individual analyses on pure substances or homogeneous mixtures and estimate the deviation of the analytical processes. The author is doing this, and would be glad of the co-operation of any of the readers of the Bulletin who are interested. Incidentally, really homogeneous mixtures are not as easily prepared as might be supposed. Few of the dealer's samples are homogeneous within the precision of the analytical process.

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### A COMPARISON OF METHODS USED IN THE DETERMINATION OF CHLORAMINE

(Abstract)

T. JOSEPH BROWN

A stock solution of chloramine was prepared by taking equal volumes of chlorinated water and sodium hydroxide of equivalent strength and then adding an equivalent amount of ammonium hydroxide. This stock solution was then diluted to make standard solution containing 0.1, 0.2, 0.4, 0.6, 0.8, and 1 p. p. m. available chlorine. The strength of each of these solutions was determined by the following tests: The square bottle; the spot plate; the Wallace and Tiernan comparator; Scott's methyl orange test; Griffin's sodium nitrite test; McNamee's Method, and the Wolfe test. The tests were run on the same day at the same temperature, 24° C, and daylight or artificial daylight from a mercury vapor fluorescent lamp was used for the color matching.

The results of the comparison are as follows: (1.) Square bottle—Matching of color difficult. Best results with standards between 0.4 and 0.8 p. p. m. (2.) Wallace and Tiernan comparator—Lack of standards in the higher concentrations gives a source of error. (3.) Spot plate gave the best results in the concentrations used. (4.) Methyl Orange test. Accuracy of the test may be questioned because of the faint pink color produced. (5.) Sodium Nitrite test. Chloramin measured indirectly thereby introducing a source of error. (6.) McNamee test. Also an indirect method. Results obtained were always below the concentrations of the stock solutions. (7.) Wolf test. Results very good when technique was developed.

The results of the comparison of the different methods indicate that the spot plate gives the best results when only the chloramin is present; and the Wolf test, when free chlorine and chloramin are present.

## AMMUNITION AND ARTILLERY IN ATOMIC TRANSMUTATIONS

(Abstract)

T. LOUIS KEENY, S.J.

Nuclear Chemistry is a fascinating subject. The Rutherford atom is composed of a nucleus of neutrons and protons with planetary electrons whirling about the center of the atom. All the chemical elements differ merely in the number and arrangement of these three fundamental building blocks of the atoms. If an atom has the same number of protons but a different number of neutrons in the nucleus we have an isotope of an element with the same atomic number but different atomic weight.

By hurling protons, deuterons, neutrons and other particles at atomic nuclei, transmutation of one element into another has been accomplished by the Lawrence cyclotron, the Lauritsen million volt X-ray tube and the Van de Graaff 10 million volt electrostatic generator. These huge "atom smashers" have realized the dream of the ancient alchemists. Fermi has added elements 93 and 94 by bombarding uranium with neutrons. For this starting achievement he won the Nobel Prize in 1939.

The researches in induced radioactivity have furnished the modern scientist with a marvelous "tracer" in the domain of chemical and biological investigations. The test for radioactivity is so much more sensitive than other physical and chemical tests that the minutest amount of material can be readily detected with delicate electron counter apparatus.

How far the proposed new gigantic 4,900 ton cyclotron will aid in solving the age old riddle of the structure of matter we can hardly realize. The ammunition may be the same as today, but the artillery will be increased twentyfold and so may the results that man will accomplish in this newest branch of knowledge.

## HIGH SPEED DE-ICING

(Abstract)

FRANCIS KEENY, S.J.

The factors controlling the formation of ice on the windshields of the various forms of transportation, airplanes, trains, autos and trucks are considered. The various ways that have been suggested to overcome this hazard are enumerated and evaluated. A solution that may be sprayed in the windshields by means of compressed air or from a hand-sprayer is proposed as a means of combating this hazard of an ice-coated windshield. The various properties of the suggested solution are given. Main trunk line railroads, highway departments, air lines using the solution are named.

# THREE MICRO METHODS FOR MOLECULAR WEIGHT DETERMINATIONS

(Abstract)

R. B. SCHMITT, S.J.

## I.—Micro Vaporimetric Method.

A modification of the classical vapor pressure method of Victor Meyer. The pressure that is produced by the vaporization of the sample in a closed system, forces a definite amount of mercury from the capillary exit tube. This is an improvement on the macro method of the ordinary Victor Meyer apparatus in several ways. The sample used for this determination may be weighed on a micro analytical balance, or even on a good macro balance. Results of many actual determinations were given.

## II.—Micro Ebullioscopic Method.

The determination of molecular weights by the rise in boiling point of solutions is a useful method for organic substances that are soluble in benzene and other similar organic solvents. Pedagogically, for students in physical chemistry this method is most helpful, because of the many chemico-physical principles involved. The essential features of the apparatus are the boiler, the undulating tube, condenser, syphon and Beckman Thermometer. This apparatus is made of one piece of glass, except of course the Beckman thermometer.

Details of all the procedures and a list of actual results were given.

## III.—Isothermic Distillation Method.

The most recent method developed for micro molecular weight determinations was developed by Barger and perfected by Niederl and the writer. Various concentrations of known and unknown solutions are made, then placed in capillary tubes, and these in turn are sealed in 4 mm. glass tubes and partially evacuated. After a definite period of time the stronger molar solution will absorb the weaker molar solution, and from the amount absorbed, we can calculate the molecular weight. The amount absorbed each day is measured by using a low powered microscope with a millimeter scale in the eye-piece. A list of actual results obtained were given.

For all three methods slides were used to demonstrate all the details.

## THE FUNCTION OF CULTURAL CHEMISTRY IN THE JESUIT COLLEGE

(Abstract)

ANTHONY G. CARROLL, S.J.

An attempt is made to fit a course in chemistry into the General College Plan, so that it is correlated with the other branches of knowledge pursued by the student who has only one year of one science during his college career. The attainment of the object of education by such a course in Chemistry is briefly proved.

It is pointed out that the amount of Chemistry that it is possible to teach in such a brief course is very small and soon forgotten, but if particular stress is laid on the scientific method of approach to a problem, and various chemical theories are explained from this angle, the student will be trained in a logical method of reasoning, he will see the application of some of his philosophy, and the chemistry course will supplement his philosophy course, especially in regard to his theses on induction, order in the universe, creation, Divine Providence and the existence of God.

The chemistry course so given is really a treatment of five theories, namely, The Atomic Theory, The Kinetic-Molecular Theory, The Periodic System, The Theory of Ionization, and Chemical Equilibrium.

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## A FURTHER STUDY OF THE ORGANIC ANTIMONIALS

(Abstract)

GERALD R. BEEZER, S.J.

The work of Palmer and Dehn in 1894 and 1901 resulted in the preparation of the organic arsines. Since that time several attempts have been made at the preparation of the corresponding stibines. No success has been attained thus far. This paper is a preliminary report of partial success in the preparation of diphenylstibine. Dehn's method for the preparation of the corresponding arsine was used, with little success at first due to the faulty composition of the zinc amalgam. High mercury compositions must be used. Complete reduction of diphenylstibinic acid can be obtained in a very short time. The product is soluble in ether. Isolation of the product is extremely difficult due to spontaneous oxidation. Improvement in this part of the process is necessary before the physical constants of the material can be determined.

The preparation of a dinaphthylstibinic acid by the method of Schmidt gave no results.

## QUANTITATIVE ANALYSIS BY SPECTROGRAPHIC METHODS

(Abstract)

GEORGE M. TIPTON, S.J.

The spectrograph has definitely taken its place in the field of quantitative analysis. There are two types of spectrographs in general use for this purpose: the prism and the concave grating instruments. The best techniques have been determined, and the optimum conditions for accurate and precise measurements have been ascertained.

The methods are many, but they can be divided first into bright line and into absorption spectra analyses. The bright line analysis depends entirely upon measurements of the intensity of certain spectral lines emitted by the unknown sample; these measurements may be either direct comparisons (Cf. methods of DeGramont, Nitche, Gerlach, and Lundegardh) or they may be indirect measurements based upon the relationship which can be established between intensity and the length of lines registered upon a photographic film or plate. The same subdivision exists for the use of absorption spectra.

An interesting adaptation of spectrographic analysis of the indirect intensity type is the use of a logarithmic sector to bring about the relationship between length of line and the intensity which has just been mentioned. By the use of such a device, a spectrogram can be taken in a few minutes which is at the same time a graph of spectral energy against intensity. By the use of Beer's law, this graph is also one which represents the relationship of spectral energy to concentration.

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## GRAM-MOLECULAR-VOLUME BOX

(Abstract)

GEORGE PICKEL, S.J.

The paper calls attention to the many corollaries derivable from Avogadro's law which seem to the author to have a great deal of pedagogical value in arousing the attention to students and clarifying their concepts. Twenty collaries so deductd are given and explained.



# MATHEMATICS

## SAMPLING TESTS ON SMALL SAMPLE STATISTICS

(Abstract)

FRANCIS W. POWER, S.J.

Methods of statistical estimation from small numbers of observations have been worked out by the British Mathematicians "Student" (W. S. Gossett) and R. A. Fisher, and are now widely used in many fields of experimental science. Some American statisticians of recent years however (especially Treloar, Deming and Shewhart) have felt that this "small sample technique" was being unduly relied on and have written several articles on this subject. Many of their arguments were supported by experimental random sampling tests. In general they offer three principal criticisms: first, that due to the inevitable wide variations in the means and standard deviations of small samples, the latter are in practise extremely unreliable for setting tolerance limits and hence for applying tests of significance.

The American authors also point out in the second place that most statisticians seem to regard the "Student" or Fisher "50% limits" as if they were the same in principle as the "probable error" of classical error theory which is set by a vertical cut-off at .6745 times the standard deviation; whereas the "Student" limits are set by the sides of an angle whose value is  $2 \tan^{-1} z$ , where  $z$  is a function of the sample size as well as the probability desired. Thirdly, that probability predictions made according to "Student's" theory do not concern a particular range, but rather of a series of ranges which vary sometimes widely from one sample to the next.

The present author conducted a series of random sampling experiments based on 349 measurements of the percent carbon and hydrogen in pure organic compounds, a statistical study in which was published last December.\* Both the carbon series and the hydrogen series were sampled 100 times at random in groups of 4 and in groups of 11. The data were treated according to Shewhart's method and also according to that of Treloar, except that the latter was extended to point out in more detail the sort of errors involved in small sample technique. At the present writing the data on  $N=11$  for the hydrogen series are incomplete.

\*Ind. & Eng. Chem. (Anal. Ed.) 11, 660 (1939)

Summary — from "Control Charts" (Shewhart)

		C(N=4)	C(N=11)	H(N=4)
Number of 50% ranges which include mean of Universe:				
	calc.	50	50	50
	found	47	49	48
Extreme values for means				
	max.	.26%	.20%	.16%
	min.	-.15%	-.14%	-.16%
Extreme values for stand. deviations				
	max.	.36%	.31%	.32%
	min.	.03%	.08%	.02%

Summary — from correlation charts (Treloar)  
Errors involved in Small Samples

Results from 100 random samplings from 349 analyses for carbon

No. 1—samples of 4

	50% range		95% range	
	calc.	found	calc.	found
Errors of 1st kind	none	10	none	3
Errors of 2nd kind	none	7	none	6
Means correctly rejected	50	46	5	none
Means correctly accepted	50	37	95	91
Total	100	100	100	100

No. 2—samples of 11

	50% range		95% range	
	calc.	found	calc.	found
Errors of 1st kind	none	5	none	none
Errors of 2nd kind	none	5	none	2
Means correctly rejected	50	44	5	5
Means correctly accepted	50	46	95	93
Total	100	100	100	100

Results from 100 random samplings from 349 analyses for hydrogen

Sample of 4

	50% range		95% range	
	calc.	found	calc.	found
Errors of 1st kind	none	11	none	5
Errors of 2nd kind	none	6	none	4
Means correctly rejected	50	41	5	1
Means correctly accepted	50	42	95	90
Total	100	100	100	100

## THE ORIGINAL MATHEMATICAL AUTOGRAPHS OF CHRISTOPHER CLAVIUS, S.J.

(Abstract)

EDWARD C. PHILLIPS, S.J.

This paper, illustrated with lantern slides of the autographs, described the manuscript works, eight in number, of Father Christopher Clavius, which are still preserved in the Archives of the Gregorian University, Rome. The material makeup of the MMS, their state of preservation and the characteristics of the author's handwriting were commented on, and an outline of the various works was indicated.

A number of letters, also included in the MMS Correspondence still preserved in Rome, were described because of their special connection with Clavius' scientific labors. These included the earliest extant autograph letter of Galileo; Clavius' answer to the accusations of the great French Mathematician Francis Vieta concerning the reform of the Calendar; a letter from Bernardino Baldi, the Abbot of Guastalla, who included a notice of Clavius in the first known "Who's Who in Mathematics", and a letter of Adrian Romanus giving the length of the sides of regular polygons having 9, 25, 27, 75 and 21,600 sides respectively.

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## A REVALUATION OF MATHEMATICAL PROBABILITY

(Abstract)

LEO J. YEATS, S.J.

The Notion of Probability an extremely confused one. The Mathematician largely at fault because of his failure to clarify the fundamental notion. Probability almost universally misconceived. Philosopher, Theologian, Scientist, and Mathematician alike attribute to probability some objective existence. It is altogether erroneous to use the abstract ratios of mathematics, which deals with the purely quantified aspects of reality in the field of perceptible qualities and movements. La Place's probability never intended to apply to anything but the entia rationis of the mathematician. It is a mistake to ever apply mathematical probability laws to the concrete. The scientist accepting the objectivity of probability erroneously lets it stand for the "sufficient reason" for the existence of physical phenomena. Distinction made between probability and possibility. Necessity of establishing the limiting value of relative frequency to have a "theory of probability" in the concrete. The error in having a common word to express logical probability and mathematical probability. No mathematical probability in Statistics. Probability essentially positive. Probability and uncertainty confused. They are always inversely related and no inverse relationship can ever be a relationship of causality.

## DEATHS OF JESUITS IN GROUPS OF THREE; THE GENERAL GROUPING OF RANDOM HISTORICAL EVENTS

(Abstract)

J. T. O'CALLAHAN, S.J.

A preliminary contribution in the May 1940 issue of the *Bulletin* gave at least partial justification for the persuasion that Jesuits die in groups of three. In the present paper it is shown by statistical analysis that the predominance of short-interval triplet groups is characteristic of a random series of historical events and hence the grouping is due to chance. The frequency distribution fits the general statistical curve Type III Pearson. It was further shown that the presence of numerous short-interval groups is also characteristic of random events when arranged in groups other than triplets; but is less pronounced, the greater the numbers of events included in a group.

The complete reasons justifying the persuasion of triplets groups was given: On the one hand the number of short interval quadruplets is so small historically and statistically, as not to attract attention, or to give the impression that events occur in groups of four. On the other hand, for the short-interval doublets, although they are very numerous, yet there are few independent short interval doublets which would not combine with the next death to form a short-interval triplet. Hence the majority of doublets occurring in the historical sequence are observed as triplets. Thus the random sequence gives rise to the persuasion that events occur in groups of three only.

Finally, it is shown in the paper, that the succession frequency distribution of time-intervals of groups of historical events when the size of the groups is increased offers a concrete example of a related series of Type III curves approaching the normal curve.

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## EARLY AMERICAN CURRICULA AND TEXT BOOKS

(Abstract)

J. P. SMITH, S.J.

Several years ago in the attic of Georgetown University there were found nearly 300 books of mathematical content printed in English through 1850. In this collection there are many first editions and a few, as far as is known, are the only copies found in any American library. With these as a background the papers outlined the teaching of mathematics in the 17th and 18th centuries in the American colonies. Continuing, the paper sketched the teaching of mathematics in Georgetown from 1793 with P. Wilson, the first mathematics professor, to Clark in 1850.

## A NEW NUMBER THEORY FUNCTION

(Abstract)

WILLIAM C. DOYLE, S.J.

The function developed in this paper grew out of study of a generalized Lambert series (see *Annals of Mathematics* Vol. 40, No. 2, pp. 353-360) in the same manner that the Moebius function is used as a recursion factor in the original Lambert series. This new function is defined,  $\sum a^{l(\frac{n}{d})} S(d) = 0$  (except  $S(1) = 1$ ), where the summation is taken over all divisors,  $d$ , of  $n$  that are congruent to one modula  $m$  (any integer), and  $l(S) = S - 1/m$ ;  $a$  is a constant complex number. By means of a study of the class of numbers congruent to one that divide  $n$ , an attempt is made to reduce the definition of the  $S$  function to a form similar to that of the original definition of the Moebius Function.

Rockhurst College,  
Kansas City,  
Missouri.

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## A NEW DERIVATION OF EULAR'S THEOREM IN TRIGONOMETRY

(Abstract)

A. F. FRUMVELLER, S.J.

A straight-forward elementary derivation is given of the exponential form for complex numbers  $a-ib$ , without the use of infinite series.

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## INFINITY AND NON-EUCLIDEAN GEOMETRIES

(Abstract)

CONRAD BILGERY, S.J.

The following topics are treated: Part I.—The establishment of various criteria. Part II.—Testing the non-Euclidean geometries of the Pathfinders. Part III.—A short criterion of the non-Euclidean geometries of Riemann and his modern disciples.

Under Part II the paper discusses: Bolyai's new method of arriving at a parallel to a given line, Lobatschewsky's Pan-geometry, proof of Saccheri's hypothesis of right angle, and a direct demonstration of Euclid's Postulate of Parallels.

# PHYSICS

## DEVELOPMENTS IN BETA RAY SPECTROSCOPY

(Abstract)

JOHN S. O'CONNOR, S.J.

A review of the problem of the continuous beta ray spectra and the apparent breakdown of the principle of conservation of energy in certain nuclear processes led to a brief discussion of Fermi's theory of Beta disintegration.

Results of experiments performed by the author at M. I. T. and Columbia which were designed to test the above theory as well as a modification of it by Konopinski and Uhlenbeck were shown.

These results obtained by an analysis of the energy distribution of electrons from Radium E give only partial confirmation to the theory.

The reason for the discrepancy between the experimental and theoretical "Fermi" curves has been recently pointed out by Konopinski and Uhlenbeck. The material used in the tests was Radium E, a relatively long lived natural radioactive element. This belongs in the so-called "forbidden" class with respect to the transition involved in disintegration. *Forbidden* being a relative term which pertains to the order of magnitude of the decay constant. The theory as originally worked out by Fermi applied only to "allowed" transitions, which till recently could not be examined by the method of the magnetic spectrometer because of the extremely small half value period involved.

Lawson of Michigan, has found in the isotope of Indium, mass 114 an artificially produced radioactive element belonging to the class which disintegrates according to the transition of the "allowed" type, and which because of a complex type of decay permits spectroscopic examination. The experimental results show essential agreement with the Fermi theory.

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## SOME LEAVES FROM THE HISTORY OF ATOMIC PHYSICS

(Abstract)

JAMES I. SHANNON, S.J.

This paper discusses briefly some of the principal landmarks in the history of atomic physics during the past fifty years, noting particularly the discovery of the principal atomic particles and something of their significance in atomic theory and experimentation. Topics discussed include: the electron, alpha rays, the establishment of the nuclear theory of the atom, the nature of X-rays, the positron, the neutron, and the fission of the uranium nucleus.

## THE KERR CELL AND THE MEASUREMENT OF EXCEEDINGLY SHORT TIME INTERVALS

(Abstract)

L. J. MONVILLE, S.J.

In the Kerr Electric Effect certain liquids are found to possess a polarizing influence when placed in the presence of a strong electric field. A Kerr Cell as a means of applying this principle, consists essentially in a short pyrex tube with plate glass ends. Into the walls of the tube are sealed two leads ending in parallel plates between which a field can be maintained. The tube is filled with nitrobenzene or some other suitable liquid.

When such a cell, with field applied, is placed between crossed Nicol prisms, the plane polarized light emerging from the first Nicol is elliptically polarized by the cell and one component is transmitted by the second prism. By connecting the plates of the cell in parallel with a spark gap and thereby actuating it by the same potential which causes the spark, the cell can be made to operate as a shutter, closing more or less quickly after the spark breakdown by merely changing the length of the leads to the cell. Thus the earliest stages of the spark breakdown may be observed.

This method is applied to a Mercury spark and it is found that of the spectrum lines observed the first: 5461A. appears  $1.3 \times 10^{-8}$  sec. after the spark breakdown; the last observed, at  $23.7 \times 10^{-8}$  sec.

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## COSMIC RAY TELESCOPES

(Abstract)

JOHN A. TOBIN, S.J.

When three counters or more in a line are actuated simultaneously, and the pulses from these counters are fed into a recording system that only registers when all three counters are actuated simultaneously, only cosmic rays have the energy to actuate the counters. The number of pulses determines the intensity, and the direction of the counters determines the direction of the cosmic rays.

A review of the construction of the Geiger-Miller Counters, and their efficiency, and the methods of making recordings led to a brief discussion of the results of experiments.

The altitude intensity curve, the latitude effect, and the East-West asymmetry were discussed from measurements by the counters. A brief history of the measurements by ionization chambers and Wilson cloud chambers was given.

The experimental work on the positron and mesotron and neutron was given with the theories about the nature of cosmic rays.

The paper was illustrated.

## REFINEMENTS IN RADIO RECEIVERS

(Abstract)

LEO J. VOLLMAYER, S.J.

Since the radio industry depends on a large listening public, receiver designers have aimed at ease of operation and fidelity of reception as features of their products. This paper discussed four important features of modern receivers.

The first of these features, Automatic Volume Control (A.V.C.), serves the three-fold purpose of preventing blasting, preventing distortion, and minimizing the effects of fading. Excessive volume, develops a voltage which is fed back as an increased grid bias to cut down the sound level to its proper value.

Tone Control, both manual and automatic, has for its purpose Fidelity, that is to effect a loudspeaker output which mirrors the transmitter's output. Specifically the low and high frequencies are boosted when the volume is low due to the ear's insensitivity to these two extremes of frequencies at low volume sound level. The filtering out of medium frequencies (by-passing them) gives the desired apparent boost of low and high frequencies.

Tuning a receiver correctly is accomplished by varying a coil's inductance or a condenser's capacity or by both operations. Automatic Tuning Systems are designed to accomplish these operations. According to their operating principle, all automatic tuning systems are grouped under three heads: Mechanical, Electrical, Electro-Mechanical. In the Mechanical a dial or a lever thrust rotates the condensers to their proper setting. In the Electrical System, pushing a button inserts a coil and condenser unit to produce the proper resonant circuit. In the Electro-Mechanical System, pushing a station button starts a motor to which the variable condensers are geared and brought to rest at the required condenser setting. Muting or silencing the receiver as the motor turns the condensers past undesired stations is accomplished in a number of ways, a common one being automatic grounding of the grid of an audio tube.

Tuning Indicators were devised to effect accurate tuning because the ear is an unreliable guide. Distortion, altho not consciously recognized by the ear seems to affect the nervous system and tires one of listening even to a good program. Tuning Indicators are possible because when a super-heterodyne circuit is off resonance (improperly tuned), the circuit automatically develops a voltage which is proportional to the amount the oscillator is off resonance and this voltage (or current) is made to operate various devices as a meter, oscilloscope tube or colored lamps.



## PHYSICS IN AN INTRODUCTORY COURSE

(Abstract)

P. W. FROEBES, S.J.

At the meeting of the Catholic Education Association held at Kansas City (Easter, 1940) a paper was read by Fr. W. C. Doyle, S.J., giving a full account of the venture—copies are still available.

The Rockhurst College Catalogue describes the course thus: The purpose of this course is to acquaint the student with the general field of science. It covers introductory material in Astronomy, Chemistry, Geology, Mathematics, and Physics. Stress is laid on man's relation to the physical world and the laws governing natural phenomena. Lectures, demonstrations, library and special project work. Required of all Freshmen. 2 Semesters. 6 Credit hours.

How is Physics handled in this course? During one of the four quarters each group of students will listen to a series of topics taken from the entire field of Physics. The topics so far presented were these:

1. The need of precise measurements in Physics, sources of error, precision instruments and their use.
2. Universal gravitation (as in Foley's College Physics).
3. The energy and work concept in Physics.
4. Galileo's leaning tower experiment (as in Cooper).
5. The radio tube and its application in Physics and in Industry. (Electron microscope.)
6. The principles of air conditioning.
7. Polarized light and the polaroid.

In the class room the student is taught to take notes which fit into a brief outline. At home these notes are expanded into a full account of the matter presented—a sample of this work was shown at the meeting. For a moderate amount of additional material especially diagrams the student is sent to the library where he can find a number of College Physics texts and other sources. The lectures stress, when opportunity arises, the need of at least a moderate amount of mathematics, of precise thinking and reasoning, the help derived from class room demonstrations and, whenever convenient, the historical setting.

By this we hope to guide the student in a prudent selection of his field of concentration, because he knows now from his own experience (1.) What is done in Physics—quite a number of students have never studied Physics before. (2.) How the course is conducted. (3.) Whether he will like the course or not. (4.) Whether his preparation, especially in mathematics, give him a reasonable assurance of success.

The course is not directly intended to "step up" the study of Physics in the Sophomore year to a five quarter course, but it has proved a saving of a good deal of time usually spent at the beginning

of the year in getting the subject under way. Only 4 or 5 of the topics listed can be fully treated in each quarter. Grades are based on neatness and completeness of the reports and on several tests. The attitude of the instructor is to encourage at all times and to arouse the interest of the student. The study of Physics is, as we all know, one which students will not readily select unless required to do so. Other courses which are less difficult and have no Laboratory work have frequently a far greater appeal.

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### MUSURGIA UNIVERSALIS OF ATHANASIUS KIRCHER, S.J.

(Abstract)

JOSEPH M. KELLEY, S.J.

The *Musurgia Universalis* of Fr. Athanasius Kircher, S.J. came to the attention of Baltimore Jesuits as part of an exhibit of books arranged by the Enoch Pratt Free Library of Baltimore. The desire to know something of a work of this Jesuit evidently valued by those not of the Society led to the writing of this paper.

The very size of Fr. Kircher's book as well as a glance at its contents, written in Latin and profusely illustrated induces respect at once for the man whose labor produced it. From a preface by the author and another by James Viva, S.J., we are able to form an idea of the purpose of the book and the difficulties in preparing it for publication. The range of subjects treated seems to justify the title "*Universalis*." Everything pertaining to sound and music came within the scope of the *Musurgia*. Though written three centuries ago it is modern enough to base its conclusion and theories on physical experiments, the most striking of which is that on Torricelli's vacuum in the barometer tube. Not the least interesting thing to note in the *Musurgia* is Fr. Kircher's reaction to the work of illustrious men of his own time, among whom were Torricelli and Kepler.

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### GREAT LAKES TIDES IN THE JESUIT RELATIONS

(Abstract)

ALPHONSE R. SCHMITT, S.J.

A resume of observations of variations in lake levels made by Jesuit missionaries in the 17th century, particularly by Fathers Andre, Allouez, Marquette and Dablon, on the shores of Lake Illinois (now Lake Michigan) and of Green Bay. Observations are shown to have been very carefully made and recorded and efforts made at rational explanations of the phenomena. These observations were made and explanations offered 15 years prior to the publication of Isaac Newton's "*Principia*" which is the starting point of modern theory of the tides.

THE "ARS MAGNA LUCIS ET UMBRAE" OF  
ATHANASIUS KIRCHER, S.J.

(Abstract)

V. C. STECHSCHULTE, S.J.

The first edition of this immense folio was published in 1644, the second in 1671. In it Kircher covers an astounding amount of material more or less closely related to the subject of Light, physiological, astronomical, geometrical, horological, illustrating the topics with uncounted diagrams and descriptions of many experiments and with erudite lore from diverse fields of knowledge. This paper attempted to give a little idea of the varied contents of the book in order to illustrate the prodigious industry and the encyclopedic knowledge of Kircher. In this book is found Kircher's description of the Magic Lantern (our present projection-lantern) of which he was the inventor.

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A WASHINGTON HOBBY SHOW AND SCIENCE EXHIBIT

(Abstract)

HERBERT P. McNALLY, S.J.

Gonzaga High School in Washington, D. C. presented its second annual Hobby Fair and Science Exposition to the public the afternoons and evenings of March 16th and 17th, 1940. Classrooms, library, cafeteria, and corridors were used for display space. Hobbies attracted much attention, but science displays and demonstrations more. Boys themselves performed all demonstrations and gave all explanations. In fact the boys ran the whole show.

Because of many visitors such a show is splendid advertisement for school. It is too, an encouragement to boys in pursuit of a hobby. It stimulates interest in science and develops a new point of contact between school and outside world.

## Report of Committee on Resolutions

Whereas the first national convention of American Jesuit scientists has just been brought to a successful close, it is the sense of this committee that the following resolutions should be spread on the minutes and that a copy of them be communicated to the various persons mentioned.

Be it, therefore, resolved:

(1) that the Reverend President and Faculty of Loyola University, Chicago, be thanked for so generously putting at our disposal the facilities of the University for this meeting;

(2) that we thank especially the Reverend Father Minister and all the members of the Loyola Community for their zealous solicitude for our comfort and convenience;

(3) that we owe a special debt of gratitude to Father A. R. Schmitt and to Father Wideman of the University Faculty for their tireless energy in preparing for the meeting and for their unfailing courtesy in serving all the sections during the sessions of the meeting;

(4) that we thank the Reverend R. B. Schmitt, President, and the Reverend Emeran Kolkmeier, Secretary of the American Association of Jesuits in Science, for giving so generously of their time in organizing this meeting;

(5) that we thank the members of the Press who gave such excellent publicity to the meeting;

(6) that we express our gratitude to the dealers in scientific instruments for their exhibits of scientific equipment;

(7) that we tender to Very Reverend Father General our affectionate sympathy and that we pledge to him our most earnest prayers in these days of tribulation;

(8) that we express our gratitude to Father Assistant, the Very Reverend Zacheus Maher, S.J., for his encouraging letter and for his constant inspiration in all our scientific work.

Committee on Resolutions

M. J. AHERN, S.J.

P. H. YANCEY, S.J.

J. S. JOLIAT, S.J.

List of Jesuits who attended the National Science Convention at Loyola University, Chicago, September 4, 5 and 6, 1940.

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|----------------------------------|--------------------------------------|
| Rev. T. H. Ahearn, Cleveland     | Rev. D. Linehan, Weston              |
| Rev. M. J. Ahern, Weston         | Rev. T. J. Love, Philadelphia        |
| Rev. J. Assmuth, New York        | Rev. J. Joseph Lynch, New York       |
| Rev. F. A. Bautsch, Milwaukee    | Rev. J. B. Macelwane, St. Louis      |
| Rev. G. R. Beezer, Seattle       | Rev. J. F. McAree, Brooklyn          |
| Rev. C. Bilgery, Denver          | Rev. P. H. McGrath, Jersey City      |
| Rev. H. M. Brock, Pomfret Center | Rev. H. P. McNally, Washington       |
| Rev. T. J. Brown, Buffalo        | Rev. J. A. McWilliams, St. Louis     |
| Rev. J. T. Busam, Worcester      | Rev. L. J. Monville, St. Louis       |
| Rev. E. Cambron, Montreal        | Rev. J. S. O'Connor, Woodstock       |
| Rev. A. G. Carroll, Boston       | Rev. G. A. O'Donnell, Boston         |
| Rev. J. F. Carroll, Milwaukee    | Rev. C. M. O'Hara, St. Louis         |
| Rev. Paul L. Carroll, Omaha      | Rev. E. C. Phillips, Washington      |
| Rev. J. E. Case, St. Louis       | Rev. F. W. Power, New York           |
| Rev. A. Coniff, Washington       | Rev. R. H. Reis, Milwaukee           |
| Rev. J. K. Connolly, Weston      | Rev. J. A. Ryan, Detroit             |
| Rev. J. P. Delaney, Baltimore    | Rev. A. R. Schmitt, Chicago          |
| Rev. J. S. Didusch, Baltimore    | Rev. R. B. Schmitt, Baltimore        |
| Rev. W. C. Doyle, Kansas City    | Rev. A. M. Schwitalla, St. Louis     |
| Rev. J. B. Esmaker, Chicago      | Rev. C. E. Shaffrey, Philadelphia    |
| Rev. F. X. Flood, Buffalo        | Rev. J. I. Shannon, St. Louis        |
| Rev. J. A. Frisch, Buffalo       | Rev. J. P. Smith, Washington         |
| Rev. P. W. Froebes, Kansas City  | Rev. T. J. Smith, Weston             |
| Rev. A. F. Frumveller, Detroit   | Rev. V. C. Stechschulte, Cincinnati  |
| Rev. C. K. Hayden, Omaha         | Rev. J. J. Sullivan, Worcester       |
| Rev. A. J. Hohman, Jersey City   | Rev. G. M. Tipton, St. Mary's, Kans. |
| Rev. J. S. Joliat, Cleveland     | Rev. J. A. Tobin, Boston             |
| Rev. F. Keenoy, Kansas City      | Rev. L. J. Vollmayer, Cleveland      |
| Rev. L. Keenoy, Denver           | Rev. A. J. Westland, Mobile          |
| Rev. J. M. Kelley, Baltimore     | Rev. C. J. Wideman, Chicago          |
| Rev. E. J. Kolkmeier, Brooklyn   | Rev. P. H. Yancey, Mobile            |
|                                  | Rev. L. J. Yeats, Spokane            |

JESUIT EDUCATIONAL ASSOCIATION  
*of the*  
 UNITED STATES OF AMERICA

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Alabama .....	Spring Hill College, Spring Hill
California .....	Loyola University, Los Angeles
California .....	Santa Clara University, Santa Clara
California .....	Univ. of San Francisco, San Francisco
Colorado .....	Regis College, Denver
District of Columbia .....	Georgetown University, Washington
Illinois .....	Loyola University, Chicago
Louisiana .....	Loyola University, New Orleans
Maryland .....	Loyola College, Baltimore
Massachusetts .....	Boston College, Boston
Massachusetts .....	Holy Cross College, Worcester
Michigan .....	University of Detroit, Detroit
Missouri .....	Rockhurst College, Kansas City
Missouri .....	Saint Louis University, St. Louis
Nebraska .....	The Creighton University, Omaha
New Jersey .....	St. Peter's College, Jersey City
New York .....	Canisius College, Buffalo
New York .....	Fordham University, Fordham
Ohio .....	John Carroll University, Cleveland
Ohio .....	The Xavier University, Cincinnati
Pennsylvania .....	St. Joseph's College, Philadelphia
Washington .....	Gonzaga University, Spokane
Washington .....	Seattle College, Seattle
Wisconsin .....	Marquette University, Milwaukee

*High Schools are not included in this list.*

Jesuit educators are maintaining and directing nearly 300 Universities,  
 Colleges and High Schools in the world.

*Laus Deo Semper.*