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of the

American Association of Jesuit Scientists

Eastern Section
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PROCEEDINGS

OF THE

TWENTY-FIRST ANNUAL MEETING

September 3rd - 4th - 5th, 1946
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EASTERN STATES DIVISION

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The Editor's Page

After four years of postponement, the American Association of Jesuit Scientists held its first post war combined meeting of the three provinces at Fordham University September 3rd, 4th, and 5th, 1946. A healthy mixture of Charter and other older members and younger members, some attending their first meeting of the complete Association, manifested throughout the convention a spirit of justifiable pride that their Association had survived the trials of the war period. Each section presented an interesting program which brought forth spirited discussion after each paper. Obvious delight that the Association was once again reunited and enthusiastic interest in the future active strength of the Organization keynoted the Meeting.

Among the reorganization problems facing the Assembly was the question of membership records. Since the last meeting a great many of ours have become eligible for membership and some of the old members for several reasons can no longer take an active part in the activities of the Association. Therefore, it was decided to disregard all previous lists and start anew. This almost hopeless task has fallen upon our newly elected Secretary, Mr. Robert O. Brennan, S.J., of Canisius College, Buffalo, N. Y. He has sent requests to one individual member in each of our houses, asking that a list of members from that house be forwarded to him. May we urge all who wish their names to be included in that list to be sure this information is forwarded to him, even though by some inevitable oversight, they may not be otherwise contacted. Since this new list will be the mailing list for the BULLETIN, it is essential that it be one hundred percent complete.

A lively discussion in general session assured the Editor of wholehearted support and cooperation in the publication of the BULLETIN. Hereafter articles for publication will be solicited by the Chairmen of the various sections. Other articles may also be forwarded directly to the Editor as in the past. The Editor is very anxious to have the BULLETIN appear promptly on publication dates, and therefore, your cooperation with the Chairmen is earnestly requested.

The return of a feature of the BULLETIN, of necessity neglected during war time, was urged upon the Editor—namely the "News Items" of our colleges and high schools. Hereafter, reminders will be sent to the heads of departments about two weeks before the deadline for each Issue. It was suggested that these "News Items" should include a brief summary of the war work done by each department of our Colleges and High Schools. To assure this worth-while and very interesting department of the BULLETIN, we ask your prompt and complete cooperation.

Programs

TWENTY-FIRST ANNUAL MEETING

OF THE

AMERICAN ASSOCIATION OF JESUIT SCIENTISTS

EASTERN STATES DIVISION

HELD AT

FORDHAM UNIVERSITY

New York, N. Y.

September 3, 4, and 5, 1946.

PROGRAM OF GENERAL MEETINGS

Tuesday, September 3, 1946—7:45 P. M.

AMPHITHEATER—PHYSICS BUILDING

A WORD OF WELCOME .... VERY REV. ROBERT I. GANNON, S.J.
READING OF MINUTES
APPOINTMENT OF COMMITTEES
PRESIDENTIAL ADDRESS .... REV. J. JOSEPH LYNCH, S.J.
The equivalence of mass and energy.
NEW BUSINESS
ADJOURNMENT

Wednesday, September 4, 1946—7:45 P. M.

AMPHITHEATER—PHYSICS BUILDING

ATOMIC ENERGY

THE CHEMISTRY OF ATOMIC ENERGY
REV. JOSEPH J. SULLIVAN, S.J.
POLITICAL IMPLICATIONS IN THE USE OF
ATOMIC ENERGY .... REV. CHARLES KEENAN, S.J.
A FEW REMARKS .... DR. VICTOR HESS, Ph.D.

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AMPHITHEATER—PHYSICS BUILDING

REPORTS OF SECRETARIES
REPORTS OF COMMITTEES
DISCUSSION
RESOLUTIONS
ELECTION OF OFFICERS
ADJOURNMENT

PROGRAM OF SECTIONAL MEETINGS

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Thursday, September 5—9:00 A. M.

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The effect of thiamine on the rat's ability to learn a maze.

PARTHENOGENESIS AND THE VIRGIN BIRTH OF CHRIST .... REV. JOSEPH S. DIDISCH, S.J.

NATURAL OCCURRING POLYPLOIDY IN DEVELOPING ALLIUM .... REV. CHARLES A. BERGER, S.J.

THE GOLGI APPARATUS: ITS STRUCTURE AND FUNCTION
REV. MICHAEL P. WALSH, S.J.

RECENT HOMINID FOSSILS FROM JAVA
REV. J. FRANKLIN EWING, S.J.

CHEMISTRY SECTION—CHEMISTRY BUILDING

CHAIRMAN'S ADDRESS .... REV. BERNARD J. FIEKERS, S.J.
The Use of Geometric Figures in Teaching Chemistry.

AN INTEGRATED SENIOR COURSE IN CHEMISTRY
REV. JOSEPH J. SULLIVAN, S.J.

THE USE OF SOLUTIONS IN PLACE OF SOLIDS IN FLAME TESTS FOR METALS .... REV. GERARD M. LANDREY, S.J.

THE INTERPRETATION OF TITRATION CURVES
REV. ALBERT F. MCGUINN, S.J.

REPORT FROM THE DEPARTMENT OF CHEMISTRY

Canisius College, Buffalo, N.Y. .... REV. JAMES J. PALLACE, S.J.
The Beckman rearrangement of alicyclic oximes; the oxidized cobalt-cysteine complex in the colorimetric determination of cobalt.

MATHEMATICS SECTION—PHYSICS BUILDING

CHAIRMAN'S ADDRESS .... REV. GEORGE A. O'DONNELL, S.J.
Linear Transformations of Complex Variables.

THE NAUTICAL MILE .... REV. ANTHONY J. EIARDI, S.J.

TEACHING SPHERICAL TRIGONOMETRY IN OUR HIGH SCHOOLS .... NORBERT T. KIDD, S.J.

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EDUCATIONAL TRANSITIONS AND FUTURE PHYSICS .... REV. JOHN A. TOBIN, S.J.

COMMERCIAL AND TECHNICAL DEVELOPMENTS IN FM BROADCASTING .... REV. LAWRENCE C. LANGGUTH, S.J.

THE MESETRON .... JOHN KINNIER, S.J.

MOMENTUM SPECTRA OF MESONS IN COSMIC RADIATION .... WILLIAM G. GUINDON, S.J.

PRODUCTION OF LOW TEMPERATURES BY MAGNETIC COOLING .... JOHN F. DEVANE, S.J.

GENERALIZATION OF THE LAW OF CONSERVATION OF ENERGY .... ROBERT O. BRENNAN, S.J.

Secretary's Report

FIRST GENERAL SESSION

The 21st Annual Meeting of the American Association of Jesuit Scientists (Eastern States Division) was held at Fordham University, New York, on September 3, 4 and 5, 1946. The first general session was called to order September 3, at 7:45 P.M. in the amphitheater of the Physics Building, the Reverend Philip H. O'Neill, S.J., presiding, in the absence from the country of the Reverend Edward C. Phillips, S.J., president of the Association. The Reverend Robert I. Gannon, S.J., President of Fordham University, welcomed the group to Fordham and placed the facilities of the University at the disposal of the Association. The secretary's report, read by the Reverend Stanley J. Bezuszka, S.J., for the Reverend Albert F. McGuinn, S.J., secretary, included minutes of the 20th Annual Meeting of the whole Eastern Section of the Association at Holy Cross College in 1941 and of the separate meetings held by the New England Province and by the Maryland and New York Provinces in August and September of the 1942 and 1943.* The minutes were accepted as read.

Father O'Neill then appointed the following committees:

COMMITTEE ON NOMINATIONS:

Rev. Henry Brock, S.J.
Rev. Charles A. Berger, S.J.
Rev. Thomas J. Love, S.J.

COMMITTEE ON RESOLUTIONS:

Rev. John P. Delaney, S.J.
Rev. John A. Tobin, S.J.
Rev. Edward L. McDevitt, S.J.

The Reverend Gerald F. Hutchinson, S.J., then introduced a discussion of the revision of the membership list and of the policy of the *Bulletin*. Various proposals were made from the floor for the improvement of the *Bulletin* and for the method of obtaining a more abundant supply of matter for publication. These proposals were referred to the consideration of the Executive Council.

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* NOTE: A meeting was also held by members from the New York and Maryland Provinces at St. Joseph's High School, August 26, 1944, the Reverend Paul McNally presiding, of which no mention was made in the secretary's report. The minutes appeared in the *Bulletin*, Vol. XXII No. 1.

The presidential address, "The Equivalence of Mass and Energy", prepared by the Reverend J. Joseph Lynch, S.J., was read by the Reverend John A. Tobin, S.J.

The session was adjourned at 9:30 P.M.

SECOND GENERAL SESSION

The second general session was called to order by Father O'Neill on September 4 at 7:45 P.M. The subject of the meeting was "Atomic Energy". The Reverend Joseph J. Sullivan, S.J., presented "The Chemistry of Atomic Energy." The Reverend Charles Keenan, S.J., managing editor of *America* discussed the "Political Implications in the Use of Atomic Energy." Dr. Victor Hess of Fordham University, the first layman to speak at any of the general meetings of the Association, made a few remarks after each of the papers. There was no general discussion from the floor.

Father O'Neill announced that the final meeting would be held at 9:30 A.M., September 5.

FINAL GENERAL SESSION

The final general session was called to order by Father O'Neill at 9:30 A.M., September 5. The results of the elections in the various sections were announced as follows:

BIOLOGY—*Chairman*, Rev. Michael Walsh, S.J.
Secretary, Mr. John Alexander, S.J.

CHEMISTRY—*Chairman*, Rev. James J. Pallace, S.J.
Secretary, Mr. Clarence Shubert, S.J.

MATHEMATICS—*Chairman*, Rev. Timothy P. Reardon, S.J.
Secretary, Rev. John J. Mulcahy, S.J.

PHYSICS—*Chairman*, Rev. Joseph M. Kelly, S.J.
Secretary, Mr. John Devane, S.J.

The Reverend John P. Delaney, S.J., read the report of the Committee on Resolutions:

Whereas, the cordial invitation of Fordham University has facilitated the planning of this 21st Annual Convention of the Association of Jesuit Scientists, and whereas, Fordham's warm welcome and cooperation has carried the meeting to a successful conclusion, be it resolved:

That the Association express its appreciations to President Robert I. Gannon, to Reverend Father Rector Harding Fisher, and to Father Minister Herbert McNally and Father Philip O'Neill and Father Edward Berry, and to members of the faculty, for their genuine hospitality and inestimable contribution to the success of our meeting, and be it further resolved:

That a copy of these resolutions be transmitted to the above-mentioned fathers.

COMMITTEE ON RESOLUTIONS:

John P. Delaney, S.J.
John A. Tobin, S.J.
Edward L. McDevitt, S.J.

A motion was made and carried to approve the resolution as submitted.

Father O'Neill then reported on the decisions of the Executive Council in regard to membership and the *Bulletin*. The decisions were in the form of recommendations to the succeeding council.

The Committee on Nominations proposed the following names to the Association:

For President, Rev. Joseph Didusch, S.J.
Rev. Frederick Sohon, S.J.
Rev. Paul McNally, S.J.

For Secretary, Mr. Robert Brennan, S.J.
Mr. Joseph Mullen, S.J.
Mr. Joseph Burke, S.J.

When Father Didusch declined the nomination because of the pressing needs of his work during the coming year, the Reverend Bernard Fiekers was nominated to take his place. Father Sohon and Mr. Brennan were elected. During the counting of the votes, Father McNally gave a short account of the expedition of the Georgetown observatory under the auspices of the National Geographic Society to take place in May 1947, and the Reverend Francis Heyden spoke of Campus Broadcasting systems.

The meeting was adjourned at 11:00 A.M.

Presidential Address

THE EQUIVALENCE OF MASS AND ENERGY

REV. JOSEPH LYNCH, S.J.

When Einstein announced his Theory of Relativity in 1905, he announced as one consequence of that theory the variation of mass with speed according to the equation

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Where

m_0 = rest mass

v = velocity of moving mass

c = velocity of light

The equation had been suggested earlier by Fitzgerald and Lorentz and had been observed experimentally in the case of the electron by Kaufmann in 1901.

As an algebraic consequence of this mass equation Einstein announced the equivalence of mass and energy according to the equation

$$m - m_0 = \frac{e}{c^2}$$

where e = k.e. of moving mass

From above $m = m_0 \left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}$

Expanding by binomial theorem

$$m = m_0 \left(1 + \frac{v^2}{2c^2} \ldots\right.$$

$$= m_0 + \frac{m_0 v^2}{2c^2}$$

$$= m_0 + \frac{e}{c^2}$$

i.e. change in mass = energy / c^2

Little attention was paid to Einstein's statement at the time because of the physical impossibility of proving or disproving it — the quantities involved being too small to measure. For example, hydrogen unites with oxygen to form water. In doing so, heat is liberated as a result of the chemical union. For 18 grams of water formed (i.e. one gram molecule) the heat liberated is found to be 2.4×10^{10} ergs.

Hence according to Einstein's equation the loss in mass should be

$$m - m_0 = \frac{e}{c^2} = \frac{2.4 \times 10^{10}}{(3 \times 10^{10})^2} = 2.7 \times 10^{-11} \text{ grams}$$

Hence per gram since 18 grams of water are formed

$$m - m_0 = \frac{2.7 \times 10^{-11}}{18} = 1.5 \times 10^{-12} \text{ grams}$$

i.e. the change in mass would be a billion billionth of a gram per gram — a quantity too small to measure. Or to take a more familiar reaction

$$1 \text{ lb. of coal} = 14000 \text{ B.T.U.} = 14000 \times 250 \text{ calories}$$

$$1 \text{ ton of coal} = 2000 \times 14000 \times 250 \text{ calories}$$

$$= 2000 \times 14000 \times 250 \times 4.2 \times 10^{7} \text{ ergs of energy}$$

the change in mass

$$= \frac{e}{c^2} = \frac{2000 \times 14000 \times 250 \times 4.2 \times 10^{7}}{9 \times 10^{20}} = 3 \times 10^{-4} \text{ grams}$$

Hence the change in mass per ton = 3 ten thousandths of a gram.

Hence in all chemical or physical heat reactions, the change in mass was too slight to be measured.

Since chemical or physical changes involve only planetary electrons, it was early recognized that any sizable release of energy that might be measured in terms of mass would have to involve the nucleus and it was also recognized that any such energy released from the nucleus would be enormous. For example, if a gram of matter could be converted into energy according to Einstein's equation $m - m_0 = \frac{e}{c^2}$

$$1 \text{ gram} = \frac{e}{9 \times 10^{20}} \quad \text{i.e.} \quad e = 9 \times 10^{20} \text{ ergs}$$

$$= 25 \text{ million K.W. hours}$$

enough energy to light this whole Physics Building for a thousand years! ! !

These outstanding figures set physicists to devising methods of reaching the nucleus of the atom. It was now accepted that the building blocks of all atoms were three—

the electron (negative)	4.8×10^{-10} E.S.U. 1.6×10^{-19} coulombs negligible mass
the proton (positive)	Same charge as E mass 1.0076
the neutron (neutral)	mass 1.0089

The neutron is a compact union of a proton and an electron. Some of the simplest atoms would be built as follows:

$_1H^1$	HYDROGEN	one proton and one electron
$_2He^4$	HELIUM	2 neutrons and 2 protons in nucleus 2 planetary electrons
$_8O^{16}$	OXYGEN	8 neutrons and 8 protons in nucleus 8 planetary electrons
$_{92}U^{238}$	URANIUM	146 neutrons and 92 protons in nucleus 92 planetary electrons

An extra neutron in the nucleus of an atom does not affect the physical or chemical properties of the atom but gives us an isotope of higher atomic wt. e.g. HYDROGEN has isotopes

(1) $_1H^1$ (one roton in nucleus)

(2) $_1H^2$ (one proton and one neutron in nucleus)

(3) $_1H^3$ (one proton and 2 neutrons in nucleus)

OXYGEN has isotopes

(1) $_8O^{16}$ (8 neutrons and 8 protons in nucleus)

(2) $_8O^{17}$ (9 neutrons and 8 protons in nucleus)

Uranium has several isotopes the two important ones being

U^{238}_{92} (146 neutrons and 92 protons in nucleus)

U^{235}_{92} (143 neutrons and 92 protons in nucleus)

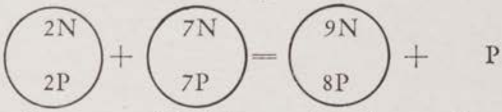
The first successful experiment involving the nucleus was performed by RUTHERFORD at Cambridge in 1925. Rutherford bombarded nitrogen with helium nuclei (a particles) and obtained oxygen according to the equation

$$ {}_{2}He^{4} + {}_{7}N^{14} = {}_{8}O^{17} + {}_{1}H^{1} $$

with a release of 6.7M.E.V. per particle.

An atom consisting of 2N + 2P, + an atom consisting of 7N + 7P = an atom consisting of 9N + 8P, + one P

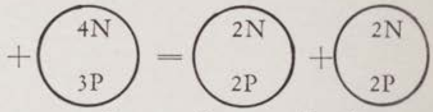
i.e.



The first successful disintegration of a nucleus was performed at Cambridge in 1932 by COCKCROFT and WALTON. Bombarding a metallic lithium target with high speed protons (hydrogen nuclei accelerated by 500,000 volts) they split some of the lithium atoms into alpha particles according to the equation

$$ {}_{1}H^{1} + {}_{3}Li^{7} = {}_{2}He^{4} + {}_{2}He^{4} $$

i.e. P



This experiment was important because it gave the first proof of Einstein's mass energy equation.

e.g. mass of Proton	=	1.0076	mass of a particle	=	4.0028
mass of Lithium	=	7.0164	mass of 2a particle	=	8.0056
		8.0240			

mass before reaction	=	8.0240
mass after reaction	=	8.0056
loss of mass	=	.0184 mass units

The energy of the resulting alpha particles as measured by their penetrability was found to be 8.5 M.E.V. per particle. Hence for the two particles formed E = 17M.E.V.

From Einstein's equation $\Delta m = E/c^2$

$$\Delta m = .0184 = 17.5 \text{M.E.V. approx.}$$

Hence for this reaction Einstein's law is confirmed.

If we compare the masses of helium and hydrogen, we find that the mass of the helium atom is less than the mass of the four hydrogen atoms of which it is composed

e.g.	mass of helium nucleus	=	4.0
	mass of 2 protons	=	2.0152
	mass of 2 neutrons	=	2.0178
			4.0330

Hence when hydrogen unites to form helium there is a conversion of .03 grams of mass (per mol) into energy. This would be about ¾ million K.W. hours for only 4 grams of helium formed. It is now thought that the heat of the sun in great part results from this union of hydrogen to form helium.

The difference in mass between a nucleus and its constituent parts e.g. a mass difference of .033 in the case of helium and its con-

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$$1 \text{ gram} = 9 \times 10^{20} \text{ ergs.}$$

$$= \frac{9 \times 10^{20} \times 10^{12}}{1.6} \text{ E.V.}$$

$$16 \text{ grams oxygen} = \frac{16 \times 9 \times 10^{20} \times 10^{12}}{1.6} \text{ E.V.}$$

$$\text{atom } O_2 = \frac{16 \times 9 \times 10^{20} \times 10^{12}}{1.6 \times 6 \times 10^{23}}$$

$$\text{mass unit} = 1/16 \text{ oxygen atom}$$

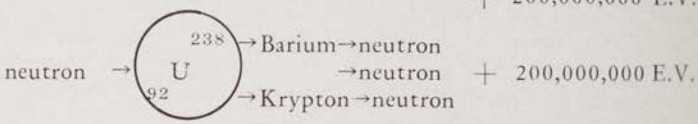
$$= \frac{9 \times 10^{32}}{9.6 \times 10^{23}} = 931 \text{M.E.V.}$$

i.e. $.0184 \times 931\text{M.E.V.} = 17.5$ M.E.V. approx.

stituent protons, gives a clue to the stability of a nucleus. If the mass of the nucleus is less than that of its constituent particles, the nucleus is stable and will not spontaneously break up into those particles but will rather be formed from those particles. If on the other hand the mass of a nucleus is greater than the mass of its constituent particles it will tend to break up into those particles.

It is found that the maximum stability lies in the middle of the periodic table. Hence the lighter nuclei tend to combine for greater stability (e.g. hydrogen combines to form helium and gives out energy) while the heavier atoms tend to split up for greater stability. It was natural therefore that experimental efforts should be directed toward splitting the heavier atoms, and in 1939 word was received that Hahn had succeeded in splitting uranium 238 according to the equation

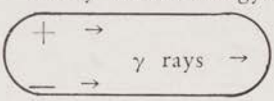
$$\text{neutron} + {}_{82}U^{238} \rightarrow \text{Barium} + \text{Krypton} \rightarrow 3 \text{ neutrons} + 200{,}000{,}000 \text{ E.V.}$$



The mass loss or splitting was in this case equivalent to 200,000,000 electron volts.

In all of these reactions so far, there has been no destruction of any particle — the number of particles has always remained the same and the change of mass could be simply interpreted as a change of inertia.

However, later experiments have shown that a positive electron (a short-lived particle with the same mass as that of the electron, and the same charge, but positive in signs — the positron, first noticed in cosmic ray investigations) and a negative electron combine to form merely radiant energy. Here



electron + positron → γ rays

we have the destruction of two particles and in their place radiant energy.

In what sense then can we say that their mass has been converted into energy?

First let us see what sense these two terms are understood by those using them.

(1) MASS is clearly being used in the conventional sense. Since the mass of all these particles is measured by means of the mass spectrograph — and hence masses are compared by means of their inertia.

(2) ENERGY is likewise used in the conventional sense. Since the unit is the electron volt or the erg. Hence energy is being used in the sense of potential work or a body's ability to do work.

Now we cannot have work done unless there is an agent which does the work — hence when we speak of two particles being converted into energy, we necessarily imply that this energy is energized matter and hence that energy itself possesses mass. It would seem therefore that theoretically at least all matter is capable of conversion into the energized matter that we call radiant energy and hence there is no philosophical repugnance in the statement that matter and radiant energy are equivalent.

There are, however, serious physical difficulties.

a) Since radiant energy has mass and it also has the constant speed of light how is Einstein's mass equation to be applied to it?

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad \text{when } v = c \quad m = d$$

b) Energy can only exist in discrete units and hence mass must be capable of only such discrete variations. Yet when a gram mass is lifted vertically against gravity its mass should decrease continuously as its potential energy is increased continuously!

(3) How are gravitational mass and inertial mass to be differentiated — or are they to be differentiated?

Science and Philosophy

PHILOSOPHICAL TRENDS AMONG MODERN SCIENTISTS

(Abstract)

REV. JOSEPH P. KELLEY, S.J.

The past twenty-five years have produced considerable literature on the general relations between Science and Philosophy. Both scientists and philosophers have contributed copiously. The prime reason for this movement is admittedly the breakdown of the Materialistic Philosophy which served as the background of thought for nineteenth century science. The new discoveries of the twentieth century demand a far broader outlook and consequently broader philosophical principles. Jeans strikes a keynote when he says: "that these new notions will show that the physics of the present day must needs have some acquaintance with ideas which used to be considered as the exclusive preserve of metaphysics." The new notions mentioned by Jeans are the new discoveries of modern science.

But beyond the general relations of science and philosophy, many individual questions of philosophical import have been raised by particular theories of science. The analysis of the theory of Entropy have led Jeans and Whittaker into a discussion of the origin of the world and creation. Max Planck has recently made a strong plea for final causes in connection with efficient causes. Heisenberg's Principle of Indeterminism has revived the problem of Free Will. The Theories of Relativity have occasioned a reexamination of Space and Time. Laws of Nature, Immortality and God have found place in scientific literature. Scholastic Philosophy offers us many sound principles for an adequate solution of many of these problems.

Biology

THE STRUCTURE AND FUNCTION OF THE GOLGI APPARATUS

(Abstract)

REV. MICHAEL P. WALSH, S.J.

This paper is a review of the very controversial literature on the structure and function of the Golgi apparatus. The vast literature on the subject is very confusing and contains widely diverse opinions on such aspects as the existence, form, chemical and physical nature, origin, and function of the structure.

Although there are still many who claim that the Golgi bodies are artefacts induced by the staining techniques that are generally employed, the majority of investigators maintain that at least some forms are real structures with a specific function. The recent work of Worley who uses a new vital methylene blue stain confirms this view.

The form of the Golgi apparatus has been described in the literature as a fibrous reticulum, network, ring or cylinder, a sphere, vesicle or cup, a collection of small spheres, rodlets, platelets or discs, a series of anastomosing canals, or a group of vacuoles.

It is the general consensus of current cytological opinion that the Golgi apparatus is intimately concerned with the process of secretion. Some maintain that the apparatus is the actual synthetic center for secretory products. Others say that the Golgi apparatus neither synthesizes secretory substances nor is directly transformed into them but that it acts as a condensation membrane for the concentration into droplets or granules of products elaborated elsewhere and diffused into the cytoplasm.

The main reason for the confusion that covers this subject is according to all reviewers the lack of specific tests. Many have in the past erroneously judged such non-specific tests as osmic acid, silver impregnation, neutral red, and Janus green as distinctly specific. Because of the absence of specific techniques, comparatively little work has been done on the structure in recent years. Some new avenue of approach is absolutely necessary if cytologists and cellular physiologists are to settle the discussions that touch almost every aspect of this problem.

RECENT HOMINID FOSSILS FROM JAVA

(Abstract)

J. Franklin Ewing, S.J.

The grouping of major hominid fossils, according to present knowledge, shows a division into a "sapiens" line (Galley Hill-Cro-Magnon; associated with the handaxe and later, flake cultures) and a "non-sapiens" line (Pithecanthropus-Sinanthropus-Neanderthal; associated with the "chopper" culture, and Neanderthal flake industries). The sapiens line is characterized by paidomorphism (large, thin-walled brain cases; retrogressive mandibles with chins, small teeth, orthognathous faces; lack of bony struts), and the non-sapiens line by gerontomorphism (small, thick-walled brain cases; large prognathous faces; chinless, heavy mandibles with large teeth; supraorbital torus). The Mount Carmel specimens show intergradation, here thought to be due to hybridization. The fossils discussed tie in with Pithecanthropus. *Pithecanthropus robustus* (Pithecanthropus IV) is large, with the thickest skull walls yet found. The diastema in the maxilla is a controverted point.

Meganthroupus palaeo javanicus, from the Trinil layers of Java, consists of a part of the mandible from symphysis to RM_1 inclusive. This is very definitely hominid (non-sapiens) in symphysis section, premolars and canine alveola; it is unusual in extreme size and in configuration of digastric region. It opens up extraordinary possibilities of giant early non-sapiens man, and speculations or relationships between giant and dwarf man and the development of the brain. A brief examination of the three huge molars, labelled by von Koenigswald *Gigantopithecus blacki*, shows many hominid characteristics in these teeth from South China, especially in the upper molar. Weidenreich asserts them to be fully hominid, but certain doubts are still entertainable, deriving from the amazing size, the talonid shape, and resemblances with fossil *Pongo* teeth. For full data cf. Weidenreich, F., *Giant Early Man from Java and South China*, Vol. 40, Part 1, Anthrop. Papers Amer. Mus. Nat. Hist., N. Y., 1945 (Semi-popular: id., *Apes Giants, and Man*, U. of Chicago Press, 1946.).

Chemistry

THE USE OF GEOMETRIC FIGURES IN TEACHING CHEMISTRY

(Abstract)

REV. BERNARD A. FIEKERS, S.J.

The triangular arrangement of fifteen pool balls provides illustrative material for the teacher of chemistry to use. Its nucleus of hexagonal symmetry allows for shifting the base of the triangle with three as the minimum number of moves. This suggests a correlation between energy and structure. The total number of speres in terms of the number along one edge is approximately equal to one-half of the square of the number along the edge. This suggests a presentation of the equilibrium concept in the difficult case where only one species reacts and its concentration has to be squared in the equilibrium expression. The use of such figures by other teachers was pointed out. A consideration of the square, the cube, the tetrahedron and the pyramid was made as the logical generalization of this type of approach. The relation of the tetrahedron to the pyramid was pointed out so as to shed light on crystalline packing.

SOLUTIONS INSTEAD OF SOLIDS IN FLAME TESTS FOR THE METALS

(Abstract)

REV. GERARD M. LANDREY, S.J.

In six test tubes are put 5 mls. of 5 per cent solutions of the salts of the commonly tested metals, and in a seventh test tube, 5 mls. of an "unknown". In each test tube is hung from the lip a 7 inch wire, No. 20, iron or soft steel, hooked at the upper end and looped at the lower end. By holding the wet end of each wire in the Bunsen flame, a momentary flash of color is seen long enough for it to be recognized. By holding the wire of the "unknown" in one hand and successively the wires of the "knowns" in the other, the difference between similar colors, e.g. crimson of lithium and carmine of strontium, can readily be determined. This method of using solutions is superior to the use of solids by reason of its tidiness, inexpensiveness, and efficiency.

Physics and Mathematics

TEACHING SPHERICAL TRIGONOMETRY IN OUR HIGH SCHOOLS

NORBERT T. KIDD, S.J. (Abstract)

Our catalogue (Saint Joseph's Prep, Philadelphia) called for plane trigonometry and solid geometry for high school mathematics last year. Spherical trigonometry could and should be worked into the solid geometry course.

Reasons for this step: the syllabus suggests it outright for "capable students"; Spatial imagination, graphical representation of this space together with all its new terminology, and the almost continuous unveiling of the newly discovered geometric forms in nature—all emphasize the need of at least a "gentleman's knowledge" of spherical trigonometry; functional thinking here is most evident.

The syllabus leaves it up to the mathematics faculty to put it at the end of either the plane trigonometry course or the solid geometry course. But most of the theorem-proving of solid geometry is secondary, according to the very words of the syllabus. Therefore its omission and the time consequently saved, leaves ample time for spherical trigonometry. Much time is left for the important thing, viz. computation both on the formulas for solids and on the formulas of spherical trigonometry.

It would seem an even better idea to combine the solid geometry and spherical trigonometry, inserting the latter wherever it is the practical application of the theory taught in solid geometry.

OPERATIONAL METHODS AND LINEAR SYSTEMS: LAPLACE TRANSFORMATION

(Abstract)

STANLEY J. BEZUSZKA, S.J.

The operational method presented is the one developed from the modern Laplace Transformation viewpoint. Because of its greater unity and generality, the Laplace method is preferable to the system of rules which were embodied in the conventional Heaviside Operational Calculus.

Several derivations of the "Functions-Transform Pairs" and "Operator-Transform Pairs" were performed to indicate the general approach. The results were then applied to specific examples to demonstrate the practical use of the method in solving the problems involving linear constant-coefficient integrodifferential equations with initial or boundary conditions. The Laplace transformation method simplifies the solution of such equations by transforming the i-d equation into an algebraic equation. This latter equation is then solved for an intermediate function, from which the solution of the original equation is obtained by applying the inverse Laplace transformation. In practice, the direct and inverse transformations are performed by a table which has been extended and prepared by several writers in the field.

THE MESON

(Abstract)

JOHN KINNIER, S.J.

At present it is believed that Cosmic Rays consist of two main components, one relatively soft and easily absorbed, the other very hard and penetrating. The soft component at sea level is composed of electrons, positrons and photons. It is almost completely absorbed by 10 cm. of lead. The hard component, however, is hardly affected by this amount of absorbing material. The primary radiation incident on the upper atmosphere probably consists of high energy protons and approximately equal numbers of electrons and positrons.

The investigation of cloud chamber photographs indicates that the penetrating component at sea level is not the proton but a particle having a mass intermediate between that of a proton and an electron. The existence of such a particle agrees well with the theoretical predictions of Yukawa. This particle is now known as the meson or mesotron. It can be characterized as follows: mass about 200 times that of the electron; charge either positive or negative; it has a radioactive life of about two microseconds.

The following facts recently published may also be of interest. They did not form a part of the paper.

This particle was discussed last week at the meeting of the American Physical Society. The results may be summarized as follows: Instruments placed in the head of V-2 rockets which reached a height of 102 miles recorded, according to Dr. Allen of Johns Hopkins, a region 100,000 feet thick between the heights of 20 and 40 miles of very high cosmic ray intensity. Showers at this height are 300 times more frequent than at ground level.

According to Fretter and Brode the mass of the meson seems to be exactly 202 times that of the electron. This figure was obtained by a study of mesons artificially produced by the Betatron.

PRODUCTION OF LOW TEMPERATURES BY MAGNETIC COOLING

(Abstract)

JOHN F. DEVANE, S.J.

The paper presented a discussion of the research on the production of temperatures in the region below 1°K. Thermo-dynamically the process is a question of decreasing the entropy of a substance thus leaving it in a state of greater order and consequently with a lower temperature. Actually the experimental process is very complicated. Only those paramagnetic salts whose internal magnetic diapoles show a random spacial orientation even at 1°K can be used. While thermally insulated the salt is subjected to a very strong magnetic field. The consequent magnetic orientation causes a decrease in the entropy due to positional disorder and the orientation itself produces heat. The heat generated is removed by allowing liquid helium at 1°K to come in contact with the salt. After the helium is pumped off and the salt again thermally insulated, the magnetic field is removed and an adiabetic demagnetization results during which the temperature of the salt drops to a very low value. Using this method experiments have been carried out in the region between 0.03°K and 1°K without difficulty. Some experimenters have been able to obtain temperatures as low as 0.005°K.

THE GENERALIZATION OF THE LAW OF CONSERVATION OF ENERGY

(Abstract)

ROBERT O. BRENNAN, S.J.

The Law of Conservation of Energy, first discovered in the science of mechanics has been generalized, especially through the work of Mayer and Joule, to include all forms of energy that are capable of measurement. The Mass-energy change, as enunciated by Einstein and verified by experiment, militates against the absolute universality of the law. The law would remain perfectly universal if the concept of energy were generalized to include mass as a form of energy just as heat is conceived as a form of energy. This is equivalently done by those who propose a law of conservation of mass and energy, otherwise the sum of mass and energy would be meaningless.

There is no philosophical difficulty so long as it is conceded that both masses and energy are accidents of a material substance.

SUGGESTED TOPICS FOR ARTICLES TO BE PUBLISHED IN THE BULLETIN

It is gratifying to realize that the BULLETIN was one of the first items to rear its head in a crop of publications that started shortly after the first World War. Accordingly, if we are to cull suggestions for its reorganization in the postwar period of today, we should best consult the issues that appeared at the time of its most poignant growing pains. Further, its contemporaries in the various sciences furnish material to amplify these suggestions. Indeed, their ever more specialized character as newer journals appeared, their content, their spirit, and especially the clientele to which they cater, conspire to justify the very existence of our Jesuit Science Bulletin, as it is familiarly called. The BULLETIN'S content will be particularly adapted to the problems of Jesuit education in science. Its spirit is that of the founding fathers of the ASSOCIATION who hoped to establish for generations of scientists in the new Society, what Clavius and Ricci in the sixteenth century had done to pave the way for Kircher, Schott, Grimaldi, Boscovitch and a host of others up to the time of the suppression. The BULLETIN'S clientele, it cannot be overemphasized, is Jesuit.

Any journal, worthy of the name, has its own character and personality. Most of the major scientific journals are intent on: 1) collecting scientific data, 2) cataloging lieterature for the purposes of availability, and 3) critically reviewing the literature for purposes of scientific generalization. Our publication, it seems to the writer, possesses none of these as primary objectives. Thus the Jesuit is free to publish in the major literature according to the spirit of the Institute. As a group, we are not preoccupied with the accumulation of material data. Our common training puts us in an eminent position, however, to evaluate facts out of rich cultural background; and, lest perchance we exceed our competence at times, most of us have been given some specialized scientific training for acquiring greater familiarity with organized factual material in our complex modern civilization. It is this common background that brings us together to discuss our common problems.

We are fitted to use the facts in order to rise above them. In our community recreations we speak of things that raise us above the toil of the day that is finished and somehow prepare us for the next. While few would accuse the so-called "scientists" among us of being "shop-talkers" in recreation, still few would deny that shop-talk provides recreation for the scientist at times. Outnumbered as we generally are in our communities, we conduct from time to time such a recreation in print through the pages of the BULLETIN. This construction puts the writer in the position of Father Nadal to write a catalog on the subjects suitable for the discussion of "ours" in times of recreation.

The matter that is to appear in the BULLETIN provides two alternatives: 1) articles of content, and 2) articles of teaching method.

The form of the BULLETIN depends upon the decision of its editor. Still each can contribute in such a way to make a definite form possible. In its back-files, we find one issue devoted wholly to astronomy. As yet, how many of the other sciences have been represented with an issue of their own? It is generally undesirable to finish a major article and to begin a new one on one and the same page. One solution of the problem, from current practice in secular journals, is not to waste the space at the foot of the page, but rather to use shorter contributions, or deliberate fillers for the sake of efficiency. It is to be remembered that photographs and diagrams contribute to the form. Tabulations can be adroitly tailored for the purposes of publication.

It is the spirit of the ASSOCIATION that draws on matter for its expression. The history of the Society in science and the scientific efforts of our Fathers provide content for leading articles in the spirit of Father Nadal's catalog. Our scientists sometimes feel that they are making history for others to record, and yet they forget the painful history recorded into the Relations by our Fathers who pioneered the frontiers of this country in its infancy. Our avocation has been called the "endless frontier" and the spirit of our enterprise will be distilled from our "relations" with profit a century hence. A chronicle of our work may be largely dry while the ink is still wet, but news items to be found in our backfiles are in many instances thrilling.

A bomb hovering over Hiroshima burst on all of mankind with a brilliance that far surpassed primitive man's discovery of fire. A logical scientific analysis of the phenomenon, as best it can be given at the moment, will reflect leading Jesuit thought on the event. Such a contribution is definitely needed. Even in our own fields, we find it difficult to keep abreast of outstanding modern developments. It is consoling to find in the files of the BULLETIN a treatise on the ultimate particles of matter by one who worked on them. In all leading articles of this type we easily recognize the dialect of the logic that is traditional with us, and lest inbreeding set in, we thus become much more ready to go to original secular reports and evaluate them for ourselves. Such information originating outside of our particular fields beomes much more understandable for us and provide vistas into cognate fields of learning. Time will not permit me to make a study of streptomycin at the moment. Still, one of my "seniors" requests me to direct a library thesis on the drug. My problem could be solved by turning to the BULLETIN. Not finding it treated there, I have to familiarize myself with the topic elsewhere. If time permits, I can pass my findings on. A brother Jesuit may be spared the same predicament. My work may be a suggestion for him to use this topic in seminar or in a similar thesis.

If the duplicating machines of the three provinces were to be suddenly suppressed by some government dictator, enough paper would be made available to relieve the current shortage of textbooks. Think of the experimental directions issued in our laboratories that are considered to be masterpieces by their authors. That chapter from my organic text that I had to rewrite, simply because the author revises the even chapters for his second and fourth edition and the odds for his third and fifth—would that make a contribution? I am sure that I have the last word on the subject.

Administrative data: the charging and distribution of chemicals; a cataloging of apparatus in the physics laboratory; lists of government surplus; the list of combination subscriptions to journals that I may have worked out,—all of these may bait an anxious editor at least to accept copy for reserve; but the published contribution might find its way not only into the chairman's files but as well into the traditions of a Province or an Assistancy.

Our back files of the BULLETIN contain a number of features that may have been dropped for some very good reasons, but is seems that some of them are worth reconsidering. Book reviews seldom appear today. If the monograph is good, we would like to know about it; if some new text shows outcroppings of logic that does not agree with perennial common sense, that repeats the usual falsifications of historical matter to which we had all but become accustomed, or that adopts a style which is dishonest by implication, though otherwise technically sound, it would be well to call it to our attention. We once had laboratory suggestions and directions for obtaining unusual apparatus or supplies. The current publicity or publications of ours were listed. The highlights of secular scientific meetings were emphasized so that a theologian leaving Woodstock felt that he knew Professors Murnaghan, Rice or Herzfeld without ever having met them.

The year 1947 suggests featuring the anniversaries of the births of Fathers John G. Hagen, known to all of us, and of Franz von Schrank, Founder of the Botanical Gardens of Munich. For the next ten years, anniversaries of either births or deaths of the following Jesuit Scientists will be coming up: Grassi, Algue, Castel, Lauretus, Odenbach, Paffrath, Ricci, Scheiner, deVico and possibly many others. It is the practice of secular associations to observe such anniversaries for outstanding men. It would be well for us to adopt the practice. Secular organizations have a necrology committee; we too, have done well by our deceased members. Still it is becoming increasingly difficult for the editor to publish such memorials promptly. The Science News Letter and the newer journal, Chemistry, have run a series known as "Classics of Science". Classics of Jesuit Science might be a good feature to make some of the works of "Ours" available to the Assistancy and the Missions. It has been called to our attention that the late Fr. George L. Coyle once toured the American Chemical Society, lecturing on Chemical Items of Historical Interest contained in the Jesuit Relations, and that every effort to retrieve the manuscript for the purposes of publication in the Journal of Chemical Education has proved of no avail. To retrieve all of that matter might be difficult. Still an article on copper, gleaned from the two volume index of the Relations, might prove the beginning of a long series of contributions on this source material. Secular journals have combed the Bible in similar fashion. Recently the writer became interested in scientific movies for the purposes of teaching. So much material of this sort is being released that only the very best judgment should be exercised in making the proper selection. That calls for reviews of any material of this type that one may have occasion to preview at scientific meetings. For years, men have been writing theses not only in our universities, but in our Collegia Maxima as well. Certainly some of this material should be made available and brought to the light of day.

It seems to the writer that many of Ours have an eminent distaste for much of the modern educational flair for method. Still to a great extent they cannot avoid becoming addicted to it. What are our reactions to the modern streamlined examinations? On basic philosophical principle, can I approve the usual suggestion that the student mark something in each multiple choice item, provided he has some indication or reason for its truth, even though he is not certain of it? Questionnaires have come to us throughout the years of the war. Carbon copies of the replies have been kept. And in many cases the final analytic report of all replies is filed with our answers. It may cost time and effort for me to compare the picture of my department with the average departmental picture of the whole country. But it might be worthwhile. Institutions have been criticized for too great an emphasis on teaching and too little on research and productive scholarship. Others have been criticized for exactly the opposite emphasis. What are the facts in the matter? Are they readily available. Reports of departmental publications, and summaries of professional activity among the Alumni could find their way into the BULLETIN from time to time, without demanding too much of its space, thus giving the answer to any such charges. The placement of Alumni presents a sizeable problem in many institutions. A report on the solution of this problem would not be out of place. Vocational guidance is now looming large. What technique have we to suggest?

When all is said and done, the writer has not mentioned anything that "ours" have not already considered either in their usual get-togethers or in the private sessions that are enucleated spontaneously on the occasion of our annual meetings. If this paper but serves to cast some element of unity over our many deliberations, it will not have been contributed in vain. If it positively stimulates contributions to the BULLETIN, it will have accomplished its purpose.

It is the scientist's forte to work in the sweat of his brow and enjoy it. It is his almost unique privilege continually to erect monuments to the great ideals that have fired his whole being. It is his duty, one might almost say, to bequeath his pearls of great price to his fellow. For science, like the pearl, should grow by accretion symmetrically about the great central ideas that constitute its germ.

News Items

BOSTON COLLEGE

Chemistry Department

Dr. John K. Rouleau was appointed Acting Head of Department as of September, 1946. Dr. Rouleau taught Physical Chemistry at Boston College from 1935 to 1940, when he was called for service in the Ordnance Dept. of the Army. He returned to the Chemistry Department in January, 1946, after his discharge from the Army as Lt. Colonel of Army Ordnance. His work in the Army was concerned largely with administration of the explosives production program. He served as Commanding Officer of three different Ordnance plants, and in this capacity he had opportunity for close contact with the heavy chemical industry.

The present faculty and their assignments are as follows:

Dr. John K. Rouleau—Acting Head of Department, Physical Chemistry, and Instrumental Methods of Quantitative Analysis.

Dr. David O'Donnel—Organic Chemistry.

Dr. Paul Maginnity—Organic Chemistry and Quantitative Analysis.

Mr. Harold Fagan—Qualitative and Quantitative Analysis.

Fr. Thomas Butler—General Chemistry and Qualitative Analysis.

Fr. Joseph Sullivan—Physical Chemistry, Industrial Chemistry, and Nuclear Chemistry.

Fr. Joseph Barrett—General Chemistry.

Fr. Albert McGuinn—Quantitative Analysis, Biochemistry.

Fr. Anthony Carroll—General Chemistry.

Eight Graduate Assistants will devote approximately nine hours per week to laboratory instruction, mainly in the General Chemistry Lab. These eight students plus four full-time graduate students will make up a capacity graduate student group. Their graduate studies will include Advanced Organic Chemistry, Advanced Physical Chemistry, Micro Organic Analysis, Nuclear Chemistry, and Advanced Quantitative Analysis. There will be a weekly Seminar for all graduate students and staff members.

The graduate program of studies was largely dictated by requirements of the G. I. Bill for veterans, in that they must carry 12 Semester hours credit per semester in order to be eligible for full subsistence. Our program of studies will provide the 12 credits per semester and an additional six credits for a satisfactory thesis,—so that the M. S. degree can be obtained in one year. Previously we have had a two-year program for a Master's degree, and our prospective one-year program is definitely a trial program.

In order to provide for the influx of students in general chemistry our facilities had to be expanded. The only program in this expansion was the number of lockers. We had 150 boxes made to specifications, and, exclusive of the material stocked in these temporary lockers, the cost was approximately $2.75 per locker complete with tumbler lock.

As of Sept. 1942, our department is approved by the American Chemical Society for the professional Training of Chemists.

Dr. John K. Rouleau attended the Summer Conference of the New England Association of Chemistry Teachers held at Middlebury College in Vermont.

Fr. Albert McGuinn was elected a national councilor of the American Chemical Society, to take office in January 1947 for a period of three years.

A significant feature of our B. S. Chemistry program is a course in Instrumental methods of Analysis for Seniors. This course builds on physical Chemistry and elementary Analytical Chemistry. We have gradually collected the necessary instruments required for a course that would give the students a good introduction to the methods of analysis currently used in industry.

We have recently acquired a Polarograph, an instrument that has no relation to polarized light, but measures increase of current with increase of impressed E.M.F. in a cell with a dropping mercury electrode. The instrument has been rather prominent during the past few years, and many published reports prove its importance for both qualitative and quantitative analysis of inorganic substances.

Our teaching program for this year involves eight classes,—i.e a first and second semester class for the four years,—and a prospective February, '47 entering class indicates that we are committed to such a program for at least another year.

This year, for the first time, the Freshman B. S. Chem majors will be handled as a unit, and the objective for second semester will be a solid course in Qualitative Analysis.

Father Paul A. McNally has been appointed Dean of the Georgetown Medical School and Regent of the Georgetown Dental School in the place of Father David V. McCauley. Father McNally will remain Vice President of the University and Director of the Observatory and he will carry out the program of the Observatory on the Army Air Force-National Geographic Eclipse Expedition next May.

The site chosen by the Eclipse Expedition (Lat. 17° 15′ S; Long. 43° 42′ W) offers a good opportunity for photographic observations of the Southern Milky Way which cannot be reached from the latitude of Georgetown. Besides a program of photometric plates to be taken in blue and red light, the Observatory plans to make a series of long exposure on the Southern Milky Way between the constellation of Carina Sagittarius. These long exposure plates will be reproduced in an atlas that will supplement the Ross-Calvert Atlas of the Northern Milky way which was published in 1934. Dr. Ross has agreed to lend Georgetown his 5 inch lens with which he made his own atlas. This lens will be used if the Observatory can obtain the camera for it which was sold to an instrument maker in Connecticut, and a suitable mounting and drive for it.

Dr. Jose Ma. Torroja Menendez of the National Geophysical Institute of Spain has been working on some research problems at Georgetown Observatory. He will spend about six months in the United States and visit several of the larger astronomical observatories which specialize in geodetic and positional astronomy.

Sister Mary Therese, B.V.M., has transferred from the University of Michigan to Georgetown to complete her work for a Ph.D. in Astronomy.

Father Francis Heyden has completed a study of the colors of seven Cepheid variable stars in the constellation, Cygnus. The observational material for this work was provided through the generosity of Harvard Observatory. It includes about 1000 plates taken in blue, red and yellow light. The observations constituted the major programs for two of the Harvard telescopes during the summers of 1944 and 1945. Spectra of the seven stars were obtained through the kindness of Dr. Struve of Yerkes and MacDonald Observatories. The results of this study definitly show that the Cepheid variable is a valuable type of star for determining not only the distances of very remote objects but also for measuring the amount of absorption of a star's light caused by clouds of interstellar dust between the sun and the star.

Mr. William P. Devereux is measuring a portion of the light curve of Nova T Coronae Borealis, the star which repeated its outburst of 1866 last February. He is using a series of Georgetown plates which cover the period from May to October. Mr. Devereux is doing this work at Woodstock.

In September 1946, Dr. Andrew P. VanHook came to the department in the capacity of assistant professor in charge of physical chemistry. Having received his doctrine at New York University (Univ. Heights Div.) in 1934, he brings with him long and varied experience in teaching, research and activity in professional societies. He has been associated with Lafayette, Idaho and Wyoming. He is best known in the fields of kinetics, crystallization and the theory of liquids.

Upon the resignation of Prof. J. J. Casey from the staff in June 1946, Prof. C. B. Murphy, H. C., M.S. '42, comes to us in his place. The staff is now comprised of five lay professors and one Jesuit.

Eight graduate students started work for the Master of Science Degree in Chemistry in September 1946, thus resuming a tradition that had lapsed in August 1944. During the duration, sixteen men graduated from the department with this degree.

On February 21, 1946 the college was host to the Worcester Engineering Society and the Worcester Chemists' Club on the occasion of their annual joint meeting. After dinner, Dr. Eugene C. Rochow of the General Electric Co. in Schenectady addressed the societies and gave demonstrations on the Silicones. On May 11, 1946, the college was also host to the Eastern Association of Physics Teachers. Father Rector welcomed the Association; Father Linehan of Weston College and Father Fiekers of Holy Cross read papers. Father Connolly featured an exhibition of all experiments being done in the Department of Physics. On May 21, 1946 Dr. Joseph F. Manning, H. C., M.S. '38, co-author of Mason and Manning, a recent book on the Technology of Plastics and Resins, spoke before the Worcester Chemists' Club at the college on recent advances in the plastics industry. Dinner for the first two meetings was held in the students' dining room in Kimball Hall. It is expected that the New England Association of Chemistry Teachers will convene here on or about May 10, 1947.

Papers presented by the staff include the following: Nov. 28, 1945, Prof. J. J. Casey at Clark University on the Boranes; Dec. 11, 1945, Father Fiekers at the Holy Name Society of St. Paul's Church, Worcester, on the Atom Bomb; Dec. 19, 1945, Mr. C. B. Murphy at Clark University on Modern Explosives; Mar 6, 1946, Mr. C. B. Murphy at Clark University on the Action of Nitric Acid on Ethers; Apr. 10, 1946, Prof. J. J. Tansey at Clark University on Sulfamic Acids; Apr. 18, 1946, Fr. Fiekers to the Scientific Society of St. Paul's School, Concord, N. H. on Gas Law Illustrations; May 11, 1946, Fr. Fiekers to the Eastern Association of Physics Teachers at the college on Gas Law Illustrations.

No classes were scheduled for the summer of 1946. Dr. O. L. Baril spent most of the summer in laboratory on consultancy work.

Father Fiekers taught physical chemistry for five weeks at the Boston College Summer School. Father Joseph Burke of the Oregon Province did research work in the department during the summer.

Laboratory courses in ultimate organic analysis on the micro-scale have at long last succumbed to those in semi-micro and micro-quantitative organic analysis here at the college. This action was precipitated by the fact that some of our graduates were not allowed credit for their micro-course. The change to undergraduate semi-micro has been completed; further introduction of micro-analysis in combination with this is being contemplated for graduate students, especially in view of the fact that we have the micro-balance at hand. We plan to have graduate students do micro-chemistry, first by way of research, and later, a graduate course may be introduced. Thus we surmise that ours is the only laboratory in Worcester that is equipped for micro-analysis.

HOLY CROSS COLLEGE—PHYSICS DEPT.

The Physics Department is this year introducing a course in Electronics and pre-radar work.

A laboratory course is being developed to accompany the course in Modern Physics.

Twenty-one Freshmen registered for the B.S. in Physics. Fourteen Sophomores are already in the course.

The Observatory under the direction of Fr. Connolly is being completely renovated and will soon be ready for operation. The telescope is a Zeiss visual, 5 and 1-8 inch apparatus with 77 inch focal length. It is equatorialy mounted and is equipped with a good set of optical accessories.

The Department gave a two-hour objective test in Algebra to every Freshman. The results will aid in the classification and placement of various groups. All freshmen except A.B. Greek are taking Math.

Fr. John Fitzgerald is attending the University of Detroit for studies in Electrical Engineering.

16 men from the last four years have gone on for graduate studies in Physics or Engineering.

ST. JOSEPH'S COLLEGE—PHYSICS DEPT.

In addition to the regular courses included in the curriculum for those majoring in Physics, the Department is offering to evening school students an Electronics and Radio Option as well as a lecture series on Atomic and Nuclear Energy.

Besides three aircraft engines and other aeronautical equipment the College has acquired from government surplus property some 500 optical parts, lenses, prisms, etc., from fire control equipment manufactured at the Frankfort Arsenal.

An extensive list of electronic surplus material is also en route from the Philadelphia Signal Depot.

Mr. Eduard S. McCauley, a graduate of Penn. State and a nephew of Fr. S. Kirsch, S.J. has been appointed Laboratory Assistant in Physics.

WESTON COLLEGE—SEISMOLOGY DEPT.

Work has started on the new Seismology Building at Weston. The building will be 100x65 feet and one story high. It is being constructed of brick and Maginnis and Walsh the architects have kept the general design of the main college building in this building. The contractors are Thomas O'Connor and Company of Cambridge. The six massive seismometer piers have been poured to bedrock and the concrete work on the building foundation has also been completed.

The new Linehan-Arringdale seismograph has been completed as a working model. The instrument is completely electronic and the record is made with pen and ink. In recent tests at Weston registrations of various earthquakes and microseisms, demonstrate that for some earth periods this instrument has a higher magnification than the Weston or Harvard Benioffs. It is expected that the finished instruments will be coming off the assembly line within a few months. The officials of the U. S. Coast and Geodetic Survey have examined this intrument and have announced that the recording assembly, especially, is the best they have seen in this type of equipment. They have ordered three of the three-component instruments to be delivered to them as soon as possible. Three other colleges have also suggested their orders for similar instruments.

The former seismic field truck has given way to a newly acquired 1½ ton Navy truck. This was second hand as we received it but in very good shape. This will permit us using a larger body than before and increasing the amount of instrument carrying space. We have obtained a second hand all steel body from the Hood Milk Company that just fits our needs for this truck.

WOODSTOCK COLLEGE

Biology Department

During the summer and fall numerous specimens of snakes were captured in the vicinity of Woowstock and kept alive for observation and study in the laboratory. About seventeen specimens in all were taken, including the black racer, pilot blacksnake, common water snake, garter snake, ring-necked snake, Valeria's snake, milk snake, hog-nosed and queen snake. A fine copperhead was captured by Mr. Anderson Bakewell, S.J. and later donated alive by him to the American museum of Natural History of New York.

During the early summer, also, Fr. William McClellan, S.J. gave a very interesting lecture on the structure and habits of our common snakes and demonstrated the feeding process with a live specimen.

Observations were made by Mr. Joseph Hanzely, S.J. of the habits and behavior of the digger-wasp, Ammobia Pennsylvania (Linn.), whose nests during the latter part of the summer were very abundant in one of the storage houses.

As the result of many entomological field trips during the summer, Mr. Hanzely has added numerous specimens, particularly of beetles and moths and butterflies to his collection.

Mr. John Bauer, S.J. recently arrived from Fordham is continuing his studies on growth characteristics of Protozoa.

Chemistry Department

A laboratory for the blowing and manipulation of glass has been constructed in the chemistry laboratory by Fr. George Hilsdorf, S.J.

The first year philosophers received an introductory college chemistry course during the summer session. The text used was "Brief College Chemistry" by L. B. Richardson and A. J. Scarlett. Several educational films were shown in the course of the lectures. These films dealt more with the theoretical aspects of the subject than with the industrial applications of the principles. Two films treated the kinetic molecular theory, one electrochemistry and a fourth the theoretical background of synthetic rubber.

Mathematics Department

The following courses are being offered for those studying mathematics:

First Year: A semester of Analytic Geometry and one of Differential Calculus.

Second Year: A semester of Integral Calculus and another of Differential Equations.

Third Year: Advanced Calculus; including topics from Solid Analytic Geometry, Partial Differentiation and Multiple Integrals, introdution to the functions of a complex variable, etc.

Physics Department

The special Physics program introduced by Fr. James Hennessey, S.J. has been in operation for the past two years. Philosophers doing special work in Physics, beyond the general course offered to all, take the following Physics courses:

Mechanics and Heat (2 semesters)—Text: Introduction to Mechanics and Heat—*N. H. Frank.*

Electricity and Optics (2 semesters)—Text: Lessons and Problems in Electricity—*N. C. Page.*
Principles of Physics III Optics—*F. W. Sears.*

25 laboratory experiments of the general College Physics level.

25 laboratory experiments exemplifying selected topics of the above mentioned special courses.

CHEVERUS HIGH SCHOOL

The old Cheverus High School building, with one hundred years tradition, twenty-five as a Catholic High School for boys, has given way to the new Sears-Roebuck of Portland. The beginning of the school year found the school in temporary quarters in a renovated building on the Cathedral property. Since there is no provision in this building for laboratory space, the science departments are using the laboratories of the near-by girls Cathedral High School. Considerable renovation was done for the larger numbers in the boys science classes. Chemistry and physics still share the same class and laboratory space. The laboratory tables from the old school have been set up in the present location. The science teachers rejoice in a common feature missing from the old school—a combination stock room, work room, dark room.

The Clavius Club held its first meeting of the year on the evening of October 16th to discuss plans for the coming year. For the first time in the history of the school four boys will be entered in the Westinghouse Science Talent Search.

You've heard of Jesuit Bark but did you know there is an "Ignatian Bean"? The article on alkaloids in Gilman's Organic Chemistry mentions them as a source of strychnine. As infirmarian and apothecary in our College of Manila, Brother George J. Camell, S.J. learned of their medicinal value and first introduced them into Europe. This remarkable brother gained an international reputation as a botanist in the early eighteenth century, his articles and drawings appearing in the leading English and continental journals. The British Museum still preserves his herbarium. To Brother Camell goes the credit of first sending to England what is today one of her most prized flowers. Linnaeus made his name live on by calling it the Camellia.

LIST OF MEMBERS

Present at the Twenty-First Annual Convention of the American Association of Jesuit Scientists (Eastern Section, Fordham University, N. Y., Sept. 3, 4, 5, 1946.

FATHERS

CHARLES A. BERGER	Fordham
EDWARD B. BERRY	Fordham
STANLY BEZUSZKA	Weston
FREDERICK BLATCHFORD	B. C. High School
JOHN BLATCHFORD	Jamaica
HENRY BROCK	Weston
WILLIAM F. BURNS	Holy Cross
PHILIP B. CARROLL	St. Joseph's Prep
JOSEPH F. COHALAN	Georgetown
JAMES K. CONNOLLY	Holy Cross
JOHN P. DELANEY	Loyola College
JAMES J. DEVLIN	Boston College
JOSEPH S. DIDUSCH	Loyola College
ANTHONY J. EIARDI	Boston College
J. FRANKLIN EWING	Boston College
BERNARD A. FIEKERS	Holy Cross
EUGENE A. GISEL	St. Peter's College
STANISLAUS T. GERRY	Fordham
MERRILL F. GREEN	Carroll House
ARMAND J. GUICHETEAU	St. Joseph's Prep
FRANCIS J. HEYDEN	Georgetown
GERALD F. HUTCHINSON	Portland
JOSEPH M. KELLEY	Loyola High School
LAURENCE C. LANGGUTH	Fairfield
THOMAS J. LOVE	Georgetown
J. JOSEPH LYNCH	Fordham
ANTHONY J. MacCORMACK	Weston
ROBERT B. MacDONNELL	St. Andrew House
EDWARD L. McDEVITT	Fordham
ALBERT F. McGUINN	Boston College
PAUL A. McNALLY	Georgetown
JOHN MORRIS	Cranwell
JOHN J. MULCAHY	B. C. High School
JOSEPH MUENZEN	Fordham
JOSEPH L. MURRAY	B. C. High School
JOSEPH W. MURRAY	St. Peter's College
JOHN S. O'CONOR	St. Joseph's College
GEORGE A. O'DONNELL	Boston College
PHILIP H. O'NEILL	Fordham
JAMES J. PALLACE	Canisius College
TIMOTHY REARDON	Georgetown
JAMES W RING	Boston College

THOMAS J. SMITH	Holy Cross
FREDERICK W. SOHON	Georgetown
JOSEPH J. SULLIVAN	Boston College
JOHN A TOBIN	Boston College
MICHAEL P. WALSH	Forham

SCHOLASTICS

ROBERT O. BRENNAN	Canisius College
THOMAS L. CULLEN	Woodstock
JOHN DEVANE	Holy Cross
MARTIN HENNEBERRY	Weston
JOHN J. HOODACK	Regis
NORBERT T. KIDD	St. Joseph's Prep
JOHN H. KINNIER	Fairfield
FRANCIS K. McFARLAND	Fordham
RICHARD A. MILLER	Regis
JOSEPH E. MULLEN	Holy Cross
JOSEPH F. MULLIGAN	St. Peter's College
CLARENCE SCHUBERT	St. Peter's College

MOMENTUM SPECTRA OF MESONS IN COSMIC RADIATION

(Abstract)

WILLIAM G. GUINDON, S.J.

Schein's data[1] on the altitude dependence of the number of mesons capable of traversing 10 or 27 centimeters of lead is analysed in such a way that from his results the differential and integral momentum spectra of cosmic mesons are obtained.

The derivation of these quantities rests on the suppositions that (1) the mesons have unit charge, a rest-mass of 180 electron rest-masses, and a life-time of 2.15 microseconds, (2) they suffer a constant rate of momentum loss in air, and (3) no mesons are produced below the altitude 9 kilometers.

Schein's curves of integral spectrum as a function of altitude for a given momentum (range in lead) are used to obtain an average differential spectrum as a function of altitude for a mean momentum. Then, under the above assumptions, the differential spectrum as a function of momentum at a given altitude is found, and graphically integrated to give the integral spectrum.

The results are consistent with the data for medium and low altitudes (well below 9 kilometers) and indicate the probability that some mesons are produced below 9 kilometers above sea level.

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[1]. Phys. Rev., 58, 1027 (1940).

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