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American Association of Jesuit Scientists

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PROCEEDINGS

OF THE

TWENTY-SIXTH ANNUAL MEETING

AUGUST 27, 28 AND 29, 1951

BOSTON COLLEGE

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Contents

Bulletin of the American Association of Jesuit Scientists

EASTERN STATES DIVISION

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NOTICE TO AUTHORS

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

Program

Twenty-sixth Annual Meeting

of the

AMERICAN ASSOCIATION OF THE JESUIT SCIENTISTS—EASTERN STATES DIVISION

Boston College

AUGUST 27, 28 AND 29, 1951

FIRST GENERAL MEETING

Monday, August 27, 1951 at 7:45 P.M. in the Chemistry Lecture Hall

Address of Welcome — Very Rev. Joseph R. N. Maxwell, S.J., *President of Boston College*

Report of the Secretary

The National Science Foundation — Rev. Patrick H. Yancey, S.J.

PRESIDENTIAL ADDRESS: Science in Soviet Russia — Rev. Michael P. Walsh, S.J.

MEETINGS OF THE SECTIONS

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Some Effects of Colchicine on the Metamorphosis of Culex Pipiens — Rev. Joseph E. Schuh, S.J.

The Adaption of Paramecium Caudatum to Sea Water — Rev. John A. Frisch, S.J.

The Inheritance of Antigens in the Blood of Cattle — Rev. Phillip H. O'Neill, S.J.

Recent Aspects of Biochemical Genetics — Rev. Michael P. Walsh, S.J.

The Synthetic School of Evolution — Rev. J. Franklin Ewing, S.J.

Enzymes in Protozoa — Rev. William D. Sullivan, S.J.

Some Nematode Parasites of Plants — Mr. John V. Owens, S.J.

Circulation Studies on the Cheek Pouch of the Hamster — Mr. William K. Masterson, S.J.

A Method for Respiration Studies — Mr. Alwyn C. Harry, S.J.

A Cytological Study of Several Species of Hosta — Mr. Vincent P. Stouter, S.J.

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Outline of the History of Chemical Equilibrium
Rev. Bernard A. Fiekers, S.J.

Chemical Equilibrium in Secondary Schools Mr. Bernard M. Scully, S.J.

Equilibrium in First Year College Chemistry
Rev. Gerald F. Hutchinson, S.J.

Multiple Equilibria in the Volumetric Analysis of Nickel
Rev. Albert F. McGuinn, S.J.

Equilibrium and Free Energy Rev. James J. Pallace, S.J.

General Papers

Synthesis and Properties of Some New Sulphur Compounds Rev. George J. Hilsdorf, S.J.

The Preparation and Properties of Thioacetamide Rev. Bernard A. Fiekers, S.J.

A Modification of Pearson's Method for Solving Dilution Problems Mr. George A. Duffy, S.J.

Radiation Induced Decomposition of Hydrocarbons Rev. Clarence C. Schubert, S.J.

A Report on the 1951 ACS Workshop for General Chemistry Teachers Rev. Vincent J. Beatty, S.J.

Round Table Discussion

Subject: Current Chemical Research Programs in the Colleges of the A. A. J. S.

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Homotopic Paths Rev. Charles J. Lewis, S.J.

The Theory of Finite Strain of an Elastic Body Mr. Patrick A. Heelan, S.J.

Limits—Safer and Simpler Rev. Domhnall A. Steele, S.J.

Notes on Descartes' La Geometrie Mr. James J. Fischer, S.J.

Mathematics Course in a Liberal Educational Curriculum Mr. Wallace G. Campbell, S.J.

Symposium

High School Mathematics

First Year Algebra—Teaching Techniques Mr. John E. Murphy, S.J.
Mr. John F. Henry, S.J.
Mr. John J. McDonald, S.J.
Mr. J. Joseph Hofman, S.J.
Mr. James A. Daley, S.J.

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Plane Geometry—Teaching Techniques	Mr. Robert A. Haus, S.J. Mr. Francis R. Carmody, S.J. Mr. Edward P. O'Connell, S.J. Mr. Richard A. Kenna, S.J.
Trigonometry—Evaluation of Present Syllabi	Mr. Joseph F. X. Cosenza, S.J. Mr. Sigmund J. Laschenski, S.J. Mr. Edward P. O'Connell, S.J.
Survey and Review Course of Mathematics for Seniors	Mr. Sigmund J. Laschenski, S.J.

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Curriculum Problems in a Five Year Cooperative Major in Electronic Physics	Rev. John S. O'Conor, S.J.
The Laboratory Manual in High School Physics	Rev. Joseph M. Kelley, S.J.
A High School Course in Physics	Mr. Sigmund J. Laschenski, S.J.
Visual Aids in High School Physics	Mr. Francis R. Carmody, S.J.

FINAL GENERAL MEETING

Wednesday, August 29, 1951 at 10:30 in the Chemistry Lecture Hall

Report of the Secretaries of the Sections
Report of the Resolutions Committee
Report of the Nominating Committee
Election of Officers
Meeting of the Executive Council

SECRETARY'S REPORT

FIRST GENERAL MEETING

The Twenty-Sixth Annual Meeting of the AMERICAN ASSOCIATION OF JESUIT SCIENTISTS, Eastern States Division, was called to order by the President of the ASSOCIATION, Rev. Michael P. Walsh, S.J., at 7:46 p.m. August 27, 1951 in the Chemistry Lecture Hall of the Science Building of Boston College. Fr. Walsh, immediately after his opening prayer, introduced Boston College's President, Rev. Joseph R. N. Maxwell, S.J. Father Maxwell's address of welcome was warm and short. For the first time B. C. is host to the A. A. J. S.

Rev. Joseph P. Kelly, S.J. made a motion that the minutes of the 1950 meeting be accepted as they appeared in the BULLETIN. The motion was seconded and carried.

Father President Walsh announced the Committee on Nominations:

Rev. John A. Frisch
Rev. Edward S. Hauber
Rev. Robert MacDonnell

Committee on Resolutions:

Rev. John S. O'Conor
Rev. James J. Pallace
Rev. William G. Guindon

Father Walsh made those announcements necessary for an efficient meeting and the comfort of the guests. Attendance was taken by each member signing and returning a card.

Father Walsh asked for volunteers to write the history of A. A. J. S.

At 8:03 p.m. Father Walsh introduced the Association's invited guest, Rev. Patrick H. Yancey, S.J., of the New Orleans Province, member by presidential appointment of the National Science Foundation, and Professor of Biology at Spring Hill College, Mobile County, Alabama, who spoke on the National Science Foundation. At the end of his talk, Father Yancey suggested that a telegram protesting budget cuts be sent to Senator Saltonstall. A discussion followed and a motion authorizing the President of A. A. J. S. to send such

a telegram was made by Mr. Robert O. Brennan and seconded by Fr. Joseph T. Clark. The motion was carried. The telegram sent was substantially as follows:

Hon. Leverett Saltonstall:

Please transmit to committee on appropriations the following resolution:

The American Association of Jesuit Scientists representing 27 colleges and universities throughout the U. S. assembled in convention at Boston College protests the action of the House committee on appropriations in reducing the budget of the National Science Foundation from $14,000,000 to $300,000 and requests the Senate committee restore the original amount.

(*signed*) MICHAEL P. WALSH, S.J.
President

At 8:32 p.m. Father Walsh gave his address "Science in Soviet Russia". The meeting adjourned at 9:05 p.m.

FINAL GENERAL MEETING

This meeting was called to order at 10:53 a.m. by Father Walsh in the Chemistry Lecture Hall. New sectionals were announced as follows:

Biology-Secretary—Mr. Vincent P. Stouter
Chemistry-Secretary—Mr. Robert E. Vanerin
Mathematics-Chairman—Rev. Charles J. Lewis
Secretary—Mr. Wallace G. Campbell
Physics-Chairman—Rev. William G. Guindon
Secretary—Mr. Sigmund J. Laschenski

There was a discussion on the new constitutions as they appeared in the January 1951 issue of the BULLETIN. A motion that they be accepted not as printed, but substantially as printed, was made, seconded and carried.—Mr. Janier suggested clearer policy and more effective execution in preparation of ours in Science fields. Fr. J. T. Clark suggested: (1) The formation of A. A. J. S. on a national scale. (2) That the annual meeting be held conjointly with the Jesuit Philosophical Association. (3) The mailing of advanced copies of papers to members. Fr. J. S. O'Conor agrees with the first but disagrees with the second above suggestions. Fr. J. T. Kelly commented on Provincial apathy during a 1938 Chicago meeting held to discuss a national annual meeting.—Fr. Yancey urged ours to list themselves in *American Men of Science* in order to lessen chances of a poor showing of Catholic scientists in studies using the above mentioned book as the source.

Father John S. O'Conor, Chairman of Committee on Resolutions reported as follows:

1. Be it resolved that the A. A. J. S. (E. S. D.) express its

sincere gratitude to the Reverend Father Rector, Father Minister, Fr. George Lawlor and the Community of Boston College for their cordial reception and gracious hospitality shown to the ASSOCIATION during its meeting.

2. Be it resolved that this ASSOCIATION express its heartfelt thanks to the officers of the ASSOCIATION, and to the very efficient local committee, for their cheerful generosity that has made this meeting a success.

3. Be it resolved that this ASSOCIATION express its continuing appreciation of the hidden toil of Fr. John J. McCarthy, Editor-in-Chief of the BULLETIN, in producing a journal that is a credit to the ASSOCIATION.

4. Be it resolved that this ASSOCIATION express its appreciation to Fr. Joseph P. Kelly, chairman, and the members of the Committee on the Constitutions, for their careful labors of revision.

5. Whereas this ASSOCIATION has, on the death of Fr. Michael J. Ahern, lost the inspiration of one of its Founding Fathers, its first President as well as the gracious host to our first meeting, and

Whereas it has thereby seen pass to his eternal reward one of the outstanding Jesuit scientists of our time, well known for his many lectures and radio addresses, and for the Weston Seismological Observatory which he founded and directed,

Be it resolved that this ASSOCIATION express its profound regret at this loss, and that the members commend to God the repose of the soul of this pioneer Jesuit scientist.

6. Be it resolved that the Secretary of this ASSOCIATION be instructed to send a copy of these resolutions to the Reverend Father Rector and Father Minister of Boston College, and a copy of the resolution on Father Ahern to the Reverend Father Rector of Weston College and Mr. Maurice Ahern, brother of Fr. Ahern, and Archivist at Fordham University.

(*signed*) JOHN S. O'CONOR, S.J., *Chairman*
JAMES J. PALLACE, S.J.
WILLIAM G. GUINDON, S.J.

Father John A. Frisch, Chairman of the Nominating Committee reported as follows:

For President. Fr. Edward Berry

There were no other nominations. Father Secretary was called upon to cast the vote.

A motion was made, seconded and carried that Fr. Berry remain in office as Treasurer and in case of refusal, that the Executive Council be authorized to select a new Treasurer.

The meeting adjourned at approximately 11:15 a.m.

MEETING OF EXECUTIVE COUNCIL

At 11:25 a.m. in the Chemistry Lecture Hall, Past President,

Father Walsh, in the absence of President Father Berry, called the meeting to order. The following members were present: Fr. Beatty, Secretary; Fr. Flood, Biology; Fr. Frisch, Past President; Fr. Guindon, Physics; Fr. Heyden, Past President; Fr. J. P. Kelly, Philosophy of Science; Fr. McCarthy, Editor of BULLETIN, and Fr. Walsh, Past President.

Suggestion was made that the Secretary invite through the respective Deans of the Colleges of the N. O., Miss., and Chi. Provinces the Jesuit scientists in such schools.

Meeting adjourned at 11:40 a.m.

Respectfully submitted,

(REV.) VINCENT F. BEATTY, S.J.

Secretary

Presidential Address

SCIENCE IN SOVIET RUSSIA

MICHAEL P. WALSH, S.J.

All of you are aware, no doubt, of the revolution in science, especially in the field of Genetics, that has been taking place within the last three years in Soviet Russia and her satellite states. Popular weekly magazines and daily newspapers have carried general accounts of this upheaval of science at various times during these years. Although the controversy has for the most part affected biology and especially Genetics, a more detailed analysis of all aspects of the controversy should be of interest to all Jesuit scientists. The Bulletin of the Atomic Scientists recognized its importance by devoting a full issue to it a couple of years ago. Everyone has been aware for years of the influence of Soviet philosophy on politics, history, economics and sociology. But few realize that this same philosophy is now restricting and in some cases actually completely blocking the progress of the natural sciences in Soviet Russia.

The scientific method has been replaced in Soviet science by the Party principle. The dictatorial judgment of the party leaders has long been the only norm of morality in the Soviet State. Now it has been established as the only criterion of objective scientific truth. In general the correctness of a scientific theory is determined in the minds of present day Soviet scientists by its ability to give the answers desired by the political leaders. It may seem incredible, but the Soviet argument in the Genetics controversy is as simple as this: the political leaders say that acquired characteristics are inherited because this fits dialectic materialism better; therefore it must be true, notwithstanding the weight of experimental evidence against the theory.

Genetics has been used as a political football in other countries. Hitler distorted the facts of Genetics to strengthen his race theories. Here in our own country we passed through a crisis when unreliable and unscientific statements were used to support the Eugenics movement a few years ago.

The destruction of Genetics in Soviet Russia is almost impossible to comprehend unless one is familiar with the history of the subject in that country. During the twenties and early thirties Soviet geneticists were recognized throughout the world among the leaders in this field of science. Geneticists played an important part in the development of the various five year plans of that era which demanded significant increases in crop production. Since genetics developed mostly through the revolutionary days in that country, the Soviet rulers could with some justification take credit for its success. Towards the end of this era, however, a small group, guided and inspired by a plant physiologist and agronomist named Trofim D. Lysenko was working against these prominent geneticists by trying to convince the party leaders that the possibility of transforming species by subjecting them to changed environmental conditions would be more profitable for the State and would harmonize much better with dialectic materialism than all the discoveries of Genetics. They were unable to succeed, however, in convincing the leaders as long as there was an intellectual background and respect for the freedom of science in the leaders of the day. Lenin recognized the importance of Genetics to his program of economic stabilization and gave his full support to Nicolai Vavilov one of the foremost Soviet geneticists of all time. But with the purge of the intellectuals of Russia in the late twenties, Lysenko, using the same tactics that Russia has used on so many countries, worked his way into the good graces of the party and got his chance. In 1940, he succeeded in removing Vavilov from the presidency of the Lenin Academy of Agricultural Science and had him deported to Northern Siberia where he died in 1943. A new wave of hostilities to the West in 1945 after the war gave Lysenko and his followers a stronger position and the complete endorsement of the Soviet leaders.

In the summer of 1948, the Eighth International Congress of Genetics was held in Stockholm. The Soviet Academy of Science sent word that the Soviet geneticists would not be present since they were too busy to leave their work. The nature of this work became evident a few weeks later when Soviet newspapers announced to the World a report of their genetics convention at which Lysenko read a 15,000-word presidential address which has been officially translated into English.

Lysenko's report makes Jacob Malik's speeches before the U. N. a year ago sound very mild and friendly. A good part of it was devoted to the usual haranguing and name-calling we are accustomed to meet in Soviet releases. Western Genetics was tagged as Weis-

manian-Mendelian-Morganistic Genetics. It was called impractical, idealistic, capitalistic, and a whole litany of similar adjectives. No evidence or experiments were offered, however, to weaken the universally accepted views of Genetics but just a host of generalities and outright furious blasts.

Apart from the name-calling, Lysenko's criticism of Western Genetics consisted in ascribing to geneticists views that were never held by them or which have not been held since the first few years of the science of Genetics. Like Paul Blanshard, his assistants have the knack of tracing down a long forgotten statement of dead and living geneticists to support their theses. Goldschmidt, who has made a thorough study of Lysenko's published works has said that it is not an overstatement to say that almost everything Lysenko has said about Genetics in his three major translated books and speeches exhibits a complete ignorance of the subject. He seems to be ignorant of the basic facts taught in a high school biology course.

The principal idea of his Genetics which he calls Darwinian-Michurinism is the old Lamarckian proposition which all other biologists abandoned when Mendel's results were discovered in 1900. This states that features and characteristics acquired by plants and animals from the environment in the course of their particular life span are inherited. Of course Lysenko takes all the credit and fails to even mention Lamarck. Yet, as Dobzhansky has said, Lysenko and his followers have yet to offer a single new idea, either right or wrong. All their "new" ideas were known in pre-Darwinian days. It must be emphasized here that Lysenko's biology is not just another theory in conflict with Mendel's theory and which might have something in its favor.

To prove his theory, Lysenko discussed a few experiments in practical plant breeding, some of which were known to plant growers in this country in the middle of the last century and found to be practically useless. They were experiments in grafting, mass selection and vernalization. The limitation of time prevents a detailed description of his experiments and conclusions. It is the unwarranted conclusions that he makes that has especially bothered geneticists. Details of procedures are wanting and despite the requests of Western geneticists made privately and publicly, they are still not forthcoming. He seems to have no concept of the importance of controls in experimental work. His interpretations and conclusions on the basis of the evidence he presents are far-fetched and mere drivel to most scientists. In place of experimental evidence, both he and Present, his first lieutenant, have recourse to authorities such as Darwin, Michurin, an old Russian plant grower, and Burbank. As Goldschmidt observed, he cannot quote in his favor a single living Soviet scientist whose performance is established in the scientific world. Lysenko rejects as heresies views that do not conform to these authorities. The final norm of truth that he used is the

philosophy of dialectic materialism, whatever that might be. His views must be correct since he can harmonize them, he says, with the official philosophy of the Soviet State.

The close connection of science and politics in Soviet Russia is strikingly illustrated by Lysenko's remarks at the close of the 1948 conference.

"Comrades, before I pass to my concluding remarks I consider it my duty to make the following statement. The question is asked me in one of the notes handed to me: 'What is the attitude of the Central Committee of the Party to my report?' I answer: The Central Committee of the Party examined my report and approved it. Stormy applause, Ovation. All rise."

Following this statement three of Lysenko's bitterest opponents who had argued vehemently in defense of what is termed Genetics in the rest of the world, recanted and pledged their full support to the doctrine approved and supported by the Party. Nowhere in their recantations can one find a valid scientific reason for their sudden about face. But throughout we find them reversing their stand and repeating always in favor of the Party's stand—so reminiscent of a purely political caucus. Their attitude and statements clearly show that this controversy is strictly a political matter and has nothing to do with scientific evidence as we know it elsewhere. They were forced to make a choice between science and the party. In Soviet Russia, only one choice can be made. How different is this from the Communists in this country, who refuse to be as truthful and frank when similar questions are proposed to them. There is yet another quotation that confirms the purely political nature of this controversy. It is from an issue of Pravda that reported another meeting of Soviet scientists soon after Lysenko's conference. "The Praesidium of the Academy of Science and the Bureau of the Biological Department forgot the most important principle in any science—the Party principle."

It is almost impossible to explain adequately why the Soviet leaders have supported so vigorously and whole heartedly the unfounded, unscientific and truly fantastic ideas of Lysenko. It is doubly difficult to understand their position when one realizes that through all this the party has made itself look so ridiculous which no dictatorial regime generally likes to do. It has been a great source of embarrassment to biologists and scientists outside the Iron Curtain who have always been so loyal to party line demands. They find themselves now too often on the horns of a dilemma: They must either admit the Party is wrong or as most of them have done, like Haldane and Joliot-Curie, they must pervert their scientific consciences to make statements that they know are false, with disastrous results to their self-respect. It is difficult to justify the Party's support when we realize that Lysenko's ideas can handicap their

economic progress and even wreck the work on crop improvements that was begun a few years ago on such a large scale.

An attempt to find a rational explanation for the ridiculous stand of the Party on such a relatively insignificant matter in current world politics has led American and British geneticists to a number of hypotheses. Some have emphasized that Lysenko may have been able to sell his program so easily because he stressed its practical nature. It is true Vavilov, his predecessor, said that he needed five years to perfect his plan for crop improvements whereas Lysenko claimed he would be successful in a year and a half. Needless to say, Lysenko has not made good on his promise. But perhaps the Party was willing to ignore the damage to its prestige if such a promise could come true. Lysenko does berate frequently in his report the work of geneticists devoted to pure research rather than applied research.

A second explanation offered by some is that Lysenko very cleverly tied his ideas to a litany of names that appealed to the non-scientific mind in the Party. Names like Darwin, Michurin, Timirjazev were familiar names in Soviet school books. There is no doubt that he was more successful than the geneticists in his frequent references to dialectic materialism to which they were accustomed to pay only an occasional lip-service. But none of these hypotheses, in my opinion, describes more than contributing causes of Lysenko's success.

As far back as 1933, Soviet leaders suspected the field of Human Genetics as one fraught with many dangers to their philosophy. Even in those days loyal party members were always quick to emphasize in any scientific studies they conducted the importance of environment over heredity in the development of human mental and physical characteristics. Their philosophy of State supremacy needed a theory that insisted on the importance of environment. According to these party-line geneticists, individuals who lived in an economically poorer environment and had therefore been mentally and physically retarded would tend through the inheritance of acquired characteristics to pass on to succeeding generations a poorer constitution. On the other hand, when the Soviet State improves their environment, the people would produce progressively better germ cells and so become innately superior. In a word, we have again the superman and race consciousness of the Nazis in another form. There is a difference, however, between the Soviet and Nazi theories. According to the Soviets, an inferior stock is so because of its environment, while according to the Nazis it is their inheritance that has made them so. Moreover, according to the Soviets but not the Nazis, this hereditary inferiority accumulated over many generations of living in a low economic environment can be remedied by just two or three generations of living under the Soviet State, a very quick improvement indeed.

Modern genetics on the contrary, does not assume that culturally and economically less developed people are ipso facto inherently of a lower physical and mental calibre. It was only the Eugenicists of the twenties that claimed this. Statistics and case histories show that no social stratum has a monopoly on brains and health.

Lysenko's insistence on environment as the important practical tool for crop improvement, as the only logical explanation of racism, as the only theory that would exalt the state and fit dialectic materialism—all these, but especially the last point, undoubtedly played a very important part in gaining the support of the leaders.

Statism and patriotism, two very appealing virtues to the Soviet mind, in my estimation, helped more than any other factor to raise Lysenko to the throne he holds in Soviet science. Lysenko has something new, something distinctly Soviet and not borrowed from Western minds like Mendel and T. H. Morgan. As in every other field of human endeavor, the party leaders saw in Lysenko's theory still another way of splitting from the West. Science was the last bond uniting the Soviet Union to the West. Subsequent events in all fields from atomic physics to sociology show this more clearly and convincingly. In 1949, four Soviet atomic scientists were condemned over the Moscow radio for repeating a statement of Western scientists that science cannot predict the behavior of atomic particles. Foreign physicists, in another broadcast, were attacked for their idealistic interpretations of relativity and the quantum theory. Einstein, Bohr and Heisenberg were accused of doing "Kantian acrobatics"; Joliot-Curie and Haldane were praised for their sound doctrine. Varga, a leading Soviet economist in 1948 was so unpatriotic as to have made a revolting suggestion that the impending economic collapse of the United States might not come off according to Stalin's schedule. He was removed from his job as Director of the Institute of World Economics of the All-Union Academy of Sciences. In 1949 he recanted.

In medicine, astronomy, geography, leading scientists have been rebuked for supporting Western concepts. On February 20, 1949, a United Press release said: "The government has ordered the publication of a new edition of the Soviet Encyclopedia to correct crude, theoretical and political errors. The new edition will be edited by the president of the Academy of Sciences and will illuminate universal and historic social triumphs in the fields of economics, science, culture, and art. It must exhaustively show the superiority of socialist culture over the culture of the capitalist world."

As a result of this policy we have learned in recent months that Soviet Russia had radios long before Marconi, the telephone before Bell, and airplanes before the Wright Brothers—in fact, one release claimed Joe Stalin himself discovered them. A blurb released recently from the present Praesidium of the Academy of Sciences states that the activities of scientists in every field of knowledge is

guided by the works of the genius of the coryphaeus of science, J. V. Stalin. Science books and teachers in Hungary, China, Czechoslovakia and the rest of the Iron Curtain are forced to teach this ridiculous nonsense. Since most of their political pronouncements are issued for propaganda purposes in the countries under their control, it is reasonable to assume that Lysenko has given them another outlet of propaganda for these countries, another chance to break away from the West.

With a condition like Lysenkoism before them, it is very difficult to understand how any American scientist and there are some who have made the headlines very recently, can be partisan to Communism. Yet strangely enough, there are comrades and party-liners in science in this country who refuse to believe that academic freedom and freedom of research will be destroyed in a Communistic government. Dr. Ralph Spitzer, former associate professor of Chemistry at the University of Oregon, is one of these scientists. It is hard to believe that these men can be sincere, when they read the translated works of Lysenko.

A few American geneticists who have discussed this subject have ended with a warning that something like this can happen here. They have become alarmed with the way scientific research has recently developed in this country. Where a few years ago research was conducted as a problem by one or two individuals in the privacy of their laboratories, today frequently it is being conducted on a large scale as a project with a team of investigators. This of course calls for support from public funds and large corporations. As they warn us, the wrong control of government funds could lay the ground for the rise of an American Lysenko. Such funds could retard the progress of science by injuring the freedom of research that a scientist needs unless the necessary precautions are always taken.

There is yet another lesson that scientists can take from the situation in Soviet Russia. It is one that is seldom mentioned. American scientists can so easily condemn Lysenko and Soviet science without seeing the motes in their own eyes. Too frequently in our own country and in the entire West, there have been scientists who have made statements no more unsound or unreasonable than Lysenko's—scientists who have been quick to assume the role of a theologian or philosopher. The scientist who tends to be an authority on subjects in which he lacks the proper training and background and who furthermore uses his scientific prestige to deceive the public that he is an authority on these non-scientific subjects is no different from Lysenko. Yet we have too many who lend their names and attach their scientific prestige to statements that are purely theological or entirely philosophical. I mean those scientists who pontificate on subjects like the existence of God, the truth of the Bible, and the nature of the soul with the same authoritative tone they use in

presenting a paper on some small aspect of quantum mechanics or the physiology of the earthworm. For a scientist who speaks on a non-scientific subject and who uses the prestige of his scientific position, as Einstein does so often, is guilty of the same offense that we are witnessing today in Soviet Russia. One is using the party principle as the sole criterion of truth and the other is using the scientific method just as dogmatically as the only source of human knowledge. It is just as unscientific to apply the scientific method to phenomena which are clearly not susceptible of scientific treatment as it is to apply the party principle to subjects that are strictly scientific and non-political. We must remember that American and British scientism can be just as wrong and dangerous as Soviet Statism.

Biology

SOME EFFECTS OF COLCHICINE ON THE METAMORPHOSIS OF *CULEX PIPIENS*

(*Abstract*)

JOSEPH E. SCHUH, S.J.[1]

Multiple complexes in the epithelial lining of the ileum of *Culex pipiens* were reported by Holt in 1917. Their origin and fate were elucidated by Berger in 1937. He reported these multiple complexes are built up by repeated chromosomal duplication during the long resting stage of larval and early pupal life; and that they undergo somatic reduction during metamorphosis and are incorporated into the adult ileo-colon. This was confirmed by Grell in 1946. The inhibition of the formation of the spindle by colchicine without interfering with the normal chromosomal cycle suggested it as a tool for the experimental study of this unique phenomenon. Ilea of pupae of *Culex pipiens* were treated with an 0.25 per cent solution of colchicine in Buck's modification of Ringer's solution before and during metamorphosis. The details of this technique are described in detail elsewhere by the author. (Chromosoma, in press).

Ilea, treated before metamorphosis began, remained in the larval condition having relatively few large cells. Those treated late in metamorphosis resembled an almost completely metamorphosed ileum, having a large number of small cells. Those treated at mid-metamorphosis resembled a normal ileum that had come about half-way through metamorphosis. Thus the metamorphic process of the ileum was arrested at the point where it was when the treatment began.

[1]Public Health Research Fellow of the National Institute of Health, National Cancer Institute.

Effects were also noted in the metamorphosis of the colon, which involves histolysis of the larval epithelial lining and the formation of a new lining by the ingrowth of cells from the posterior part of the ileum and the anterior part of the rectum. Histolysis of the larval ileac epithelial cells was not inhibited by the colchicine but the formation of the new lining was inhibited at the point to which it had progressed at the time when the treatment was begun.

These experimens add further confirmation to Berger's theory that these multiple complexes undergo somatic reduction during metamorphosis and become incorporated into the adult ileo-colon.

The failure of the colchicine to induce higher degrees of polyploidy in the multiple complex cells after the division of the SA-regions is probably due to a lack of any further duplication of chromosomes during interphase.

THE ADAPTATION OF *PARAMECIUM CAUDATUM* TO SEA WATER

(Abstract)

JOHN A. FRISCH, S.J.

The following species of Paramecium have been reported from brackish water with a salt content of approximately 1%: Paramecium caudatum, aurelia, bursaria, pyriform and trichium. Paramecium ambiguum has been found in salt lakes, varying in salt content from 2.8 to 6.3%. Paramecium calkinsi and woodruffi are normal inhabitants of Stuart's Pond at Woods Hole, Mass. The salt content of this pond varies from 1% at low tide to 2.9% at high tide.

The maximum salt concentration to which Paramecium caudatum has been transferred directly varies, according to different authors from 0.3 to 0.75%. Paramecium woodruffi can be transferred directly to 30% sea water (1% salt) and then, during a period of several days to 100% sea water (3% salt). Paramecium calkinsi can be transferred directly to sea water.

The maximum salt concentration which Paramecium caudatum can survive when the salt concentration is gradually increased over a period of days or weeks is approximately 1% according to most investigators. Finley however reported that Paramecium caudatum and aurelia survived with no significant change in morphology even in a salt concentration of 3.1%. Twelve attempts to confirm Finley's results using Paramecium caudatum and multimicronucleatum failed; the animals died in salt concentrations varying from 1 to 1.5%. In addition, changes in morphology were observed, the individuals decreasing progressively in length and width as the salt concentration increased, and losing from 0.4 to 0.7 pf of their volume. A progressive decrease in the rate of feeding and a corresponding progressive decrease in the rate of pulsation of the contractile vacuoles was likewise observed.

To ascertain the maximum salt concentration in which Paramecium caudatum could reproduce and live indefinitely, several thousand individuals were transferred directly to a 5% sea water culture medium. After one week, a part of this culture was raised to 10%, the remaining part being retained as a 5% culture. In the same way a part of the 10% sea water culture was raised after one week to 15%, the other part being retained as a 10% sea water culture. In the same manner 20, 25, 30, 35, 40, 45, 50, 55 and 60% sea water cultures were set up. All the cultures from 5% to 50% survived indefinitely, one set being at present nearly 9 years old. The longest a 55% culture survived was 1 year and 3 months. This was a subculture from a 50% culture which was 1 year and 5 months old. The longest a 60% culture survived was 1 year and 5 months. This was a subculture from an 8 months old 55% culture, which in turn had been subcultured from a 1 year and 1 month old 50% culture.

Paramecium caudatum therefore will thrive indefinitely in a 50% sea water culture medium, with a salt content of 1.52% and an osmotic pressure of 11.1 atmospheres; it has survived for 1 year and 3 months in a 55% sea water medium, with a salt content of 1.82% and an osmotic pressure of 13 atmospheres; and it has survived for 1 year and 5 months in a 60% sea water medium with a salt content of 2.02% and an osmotic pressure of 14.3 atmospheres.

RECENT ASPECTS OF BIOCHEMICAL GENETICS

(Abstract)

MICHAEL P. WALSH, S.J.

In recent years a good deal of research has been done on the role of the gene in the development and the physiology of the organism. *Neurospora* has replaced to a great extent *Drosophilia melanogaster*. Some of this work was reviewed in this paper. The argenine cycle was especially treated. The commonly accepted opinion is that the number of genes concerned with the synthesis of single chemical substances in the *Neurospora* corresponds to the number of chemical steps involved. A mutant gene blocks an intermediate step so that the end product is not produced.

ENZYMES IN PROTOZOA

(Abstract)

WILLIAM D. SULLIVAN, S.J.

Until recently very little investigation has been performed on the localization of enzymes in the cell. Recent investigations, though still relatively few in number, have succeeded in destroying the assumed hypothesis that the center of all metabolic respiration and

localization of enzymes is the cell nucleus. For example, it is now known that amylase is found in the chondriosomes; adenosine pyrophosphatase is found in the larger cytoplasmic granules and ribonucleic acid in the smaller granules. The proteolytic enzymes are found in the nucleus.

The present paper will treat of the localization of phosphatase in protozoa and its probable importance in cell division.

Through the Gomori technique of identifying phosphatase activity, the enzyme was discovered to be active about the perinuclear cytoplasm. In Volume twenty-eight of the *Jesuit Science Bulletin* for January, 1951 (fig. 3), the different concentrations of lead phosphate deposited by the activity of the enzyme may be seen. These different concentrations of the precipitate may be explained by the difference in amount of ribonucleic acid in that region of the cell. According to some of the authors, ribonucleic acid plays an essential role in cell division, and in the different stages of cell division varying degrees of ribonucleic acid is found in nucleolar-like bodies concentrated about the nucleus. It is probable that alkaline phosphatase is the cause of the synthesis of ribonucleic acid in these bodies having the characteristics of nucleoli.

On the basis of these results, a probable reason for the varying degrees of concentration of precipitated lead phosphate in the perinuclear cytoplasm may be given. The fact that the cell is undergoing division could mean a greater content of ribonucleic acid about the nucleus; once the nucleus has divided, the content of ribonucleic acid is at a minimum. And according to the amount of ribonucleic acid present, there will be more or less of the phosphatase activity.

SOME NEMATODE PARASITES OF PLANTS

(Abstract)

JOHN V. OWENS, S.J.

The five species of the genus *Meloidogyne* (fam. Heteroderidae) constitute one of the most important of the plant parasitic nematodes; more than 1400 species of plants, many of them of economic importance, are parasitized by this genus. The larva hatches from the egg in the soil, penetrates the root usually near the root tip. The rest of its life is spent inside the root. By the aid of its oral stylet, it pierces the surrounding cells and feeds on the cell sap. This gives rise to the so-called "giant cells" in the stele and cortex of the root. The resulting gall, visible to the naked eye, has given to these parasites the name of the root-knot nematodes. Such galls interfere with the normal development of the root system and the absorption of nutriments from the soil. Plants thus affected show a marked decrease in vigor and yield; the nematode injuries often open the way for infections by fungi and bacteria which may prove fatal to the plant.

A METHOD FOR RESPIRATION STUDIES

(*Abstract*)

ALWYN C. HARRY, S.J.

One of the most outstanding features of the volumetric microrespirometer developed by Wennesland (1951) is its simplicity of operation. The apparatus consists of the following parts: respiration chamber; compensating vessel; Plexiglass manometer block, which also contains the oxygen delivery chamber; delivery and measuring device for oxygen; and mounting and shaking device. The volume changes in the gases of the respiration chamber are concentrated by moving a stainless steel rod in the oxygen delivery chamber, until the manometer is in balance. The position of the plunger is read with a revolution counter which works in conjunction with the steel rod, and gives the volume changes in the gas phase. The conventional Warburg flasks with one sidearm and center well can be used as respiration chambers.

One of these microrespirometers was recently used by the author of this paper in a series of studies of the oxygen consumption of plant and animal tissue. With a long hypodermic needle the manometers were filled with Brodie's fluid (Dixon, 1943). One cc. of the medium was then measured into each respiration chamber and into each compensating chamber. The respiration chambers with the medium were then weighed. The tissue being investigated was then cut at the desired length and thickness, and placed in the respiration chambers which were then weighed. The difference between the weight of the respiration chamber plus medium, and the chamber plus medium and tissue was assumed to be the weight of the tissue.

Four milliliters of 20% KOH were measured into the center well of each respiration chamber, and a small roll of filter paper was placed in each well to aid in the absorption of carbon dioxide. All flasks were equilibrated with a reciprocating shaking speed of 120 per minute over a total excursion of 2 cm. for 15 minutes in a constant-temperature (25°C.) water bath. Respiration readings were taken every 10 minutes during a period of one hour. With each reading, the temperature of the water bath, the temperature of the room, and the barometric pressure were also taken.

Oxygen consumption in microliters per milligram tissue weight was obtained using the following method adapted from Dixon (1943), and Wennesland (1951).

1. The gas volume was reduced to normal temperature-pressure conditions.

2. This result was corrected by the calibration factor (0.707) of the microrespirometer.

3. The microliters of oxygen consumed per milligram tissue

weight per hour was obtained by substituting the obtained values in the following equation:

$$\frac{\mu l.\ O_2\ (N.T.P.)}{\text{Tissue wt. (mg.)} \times \text{time (hrs.)}} = \mu l.\ O_2/\text{mg. tissue wt./hr.}$$

A CYTOLOGICAL STUDY OF SEVERAL SPECIES OF HOSTA

(Abstract)

VINCENT P. STOUTER, S.J.

Ten forms of *Hosta* representing nine species were investigated in order to ascertain the chromosome number and the chromosome morphology for each form. The meiosis of mature pollen mother cells of each form was also studied. The species used in the investigation were: *H. caerulea* Trattinick, *H. Fortunei* Bailey, *H. erromena* Stearn, *H. plantaginea* Ascherson, *H. minor* Nakai, *H. undulata* Bailey, *H. Sieboldiana* Engler, *H. decorata* Bailey, and *H. lancifolia* Engler. The tenth form was *H. lancifolia* var, *alba-marginata* Stearn.

The basic chromosome number of all forms was 30. No extraordinary degree of polyploidy was found, all forms having a diploid number of 60. The conjecture of Strasburger that fragmentation occurs during meiosis was not confirmed.

Six sizes of chromosomes were found to constitute a set of nine of the ten forms investigated. Five chromosomes of the set were large, the remaining twenty-five various smaller sizes. *H. minor* appeared to have only four large chromosomes. There was additional evidence that two of the submedium size chromosomes in all ten forms are SAT- chromosomes.

Meiosis appeared to be identical in all forms with all of the stages represented. The material is characterized by a long and prominent zygotene synizesis stage, and an orientation of the axes of division of daughter secondary microsporocytes at right angles to one another.

Chemistry

THE HISTORY OF CHEMICAL EQUILIBRIUM

(Abstract)

BERNARD A. FIEKERS, S.J.

Commencing with ideas of chemical affinity among the ancients, the essential steps in deriving the equilibrium constant as we know it today were developed historically in this paper. The contributions of

the physicists leading to the relation between the equilibrium constants and thermodynamic functions were not given, but postponed for possibly a second paper.

MULTIPLE EQUILIBRIA IN THE VOLUMETRIC ANALYSIS OF NICKEL

(*Abstract*)

ALBERT F. MCGUINN, S.J.

A method was presented for diagramming the several equilibria involved in this analysis, as an aid in teaching quantitative analysis to sophomores. Some of the reactions were demonstrated, and further lecture demonstrations were suggested.

EQUILIBRIUM IN FIRST YEAR COLLEGE CHEMISTRY

(*Abstract*)

GERALD F. HUTCHINSON, S.J.

It is difficult to establish a general policy for teaching equilibrium in our colleges both as the subject matter to be taught and the time of the year when it should be taught. This follows from the differences in the preparation of our Freshmen and from the relationship of first year chemistry to Qualitative Analysis which varies in our schools. Students should be given the mathematical derivation of the equilibrium constant equation. Considerable practice should be given in calculations with this equation and in determining the effect of conditions on a system at equilibrium. Ionic equilibrium should be thoroughly treated and topics such as neutralizations, hydrolysis and common ion effect explained according to the equilibria involved.

EQUILIBRIUM AND FREE ENERGY

(*Abstract*)

JAMES J. PALLACE, S.J.

Equilibrium is connected with the free energy function, and hence with the other thermodynamic functions, through the equation: minus delta F = RTlnKeq. Thermodynamic dissociation constants for weak acids can be derived. Thermodynamic methods can be extended from equilibrium considerations to the rates of reactions as equilibrium is being approached. Hence the free energy involved in the rate of a reaction on approach to equilibrium is a measure of chemical affinity (DeDonder).

CHEMICAL EQUILIBRIUM IN SECONDARY SCHOOLS

(Abstract)

BERNARD M. SCULLY, S.J.

The less complicated concepts of chemical equilibrium can be taught in secondary school by using solid models and familiar analogies. Visualization by applying Dalton's Atomic Theory and the Kinetic-Molecular Theory must be pre-supposed. Physical equilibrium is a necessary foundation. The 3 states of gas, liquid and solid are differentiated according to molecular speed and inter-molecular distances. Chemical equilibrium is different because it consists in unlike atoms combining by chemical "force-bonds" at equal rates of composition and decomposition. Solid models of differently colored marbles or tennis balls to scale are useful. An easy reaction is N_2 plus O_2 yields 2 NO. Similar solid models (or graphs) can be used to illustrate ionic chemical equilibria. For example, using a one per cent solution of Acetic Acid, at 18 degrees Centigrade there are 6 molecules of HAc to every one ion of Hydrogen and of Acetate.

Every-day analogies give clarity and interest. Chemical equilibrium may be likened to a "cut-in" dance or a rail-road terminal where the number of outgoing trains is equal to the number of incoming trains. The Mass-Action Law is too complicated to derive in secondary school courses. Its applications, however, may be taught by use of simple problems applying the formula for a given concentration to solve for the percent yield.

THE PREPARATION AND PROPERTIES OF THIOACETAMIDE

(Abstract)

BERNARD A. FIEKERS, S.J.

Thiocetamide has come to attention recently as a hydrogen sulfide reagent in certain standard schemes of qualitative organic analysis. It is available in crystalline form from Eastman. It is used in solution of molar concentration. 6-8 drops of a molar solution provide sufficient reagent for all tests in Hogness & Johnson's laboratory manual, Chemical Equilibrium and Qualitative Analysis (1950, 3rd ed.). When cold, it probably co-ordinates or chelates many of the metallic ions. On heating for three minutes, decomposition into H_2S takes place and precipitation of sulfide follows. It is an elegant reagent for minimizing hydrogen sulfide odors in instructional laboratories. It is relatively expensive (ten cents per gram); not absolutely expensive because small quantities are used. It is desirable, however, to know its preparation against the event of delay in delivery or shortages. It is prepared from acetamide and phosphorus pentasulfide in benzene solution. Solution is decanted from P_2O_5 by-product and product is crystallized out. The reported ten percent

yield accounts for the expense. It is suggested that the yield might be enhanced by extracting from benzene with water and assaying the concentration. Work is being continued.

A MODIFICATION OF PEARSON'S SQUARE METHOD FOR SOLVING DILUTION PROBLEMS

(Abstract)

GEORGE A. DUFFY, S.J.

In the Chemistry Handbook, (*Handbook of Chemistry, Lange, 1937, p. 561*), a method called Pearson's Square is given for solving dilution and concentration problems. In this system a square is drawn. In the upper left hand corner we put the concentration of the original solution, in the upper right hand corner we put the concentration of the concentrant or diluent and in the center goes the desired concentration. Then by cross subtraction we get the ratio of the two solutions. If we have a specified amount of the original solution we then set up a proportion problem.

If however we set up a similar square but in the lower left hand corner put the amount of the original solution and in the lower right hand corner put x, the unknown amount of the diluent, then bottom left multiplied by the difference between top left and center is equal to bottom right multiplied by the difference between top right and center.

RADIATION INDUCED DECOMPOSITION OF HYDROCARBONS

(Abstract)

CLARENCE C. SCHUBERT, S.J.

During June and July 1951 at Canisius College a commercial X-ray unit was used to study the decomposition caused in cyclohexane and 2, 2, 4 trimethyl-pentane by "hot" radicals which were produced by the irradiation of 10cc. samples of the hydrocarbons with 120 KV X-rays. Varying quantities of iodine were added in the expectation that the H atoms and the methyl radicals produced in the reaction would be captured to form HI and CH_3I. It was observed that the yield of H_2 and CH_4 did not decrease with added iodine, rather the increased absorption of the X-rays by the heavy iodine atoms resulted in increased yields of the gas in an amount directly proportional to the increased absorption of X-rays by the sample. Under the direction of Dr. R. Schuler and the aid of an A. E. C. contract work is continuing to determine accurately the "G" value for the reaction, i.e. the no. of molecules produced per 100 e.v. absorbed by the system. An actinometer for X-ray work using ethyl iodine was briefly described.

SYNTHESIS AND PROPERTIES OF SOME NEW SULPHUR COMPOUNDS

(*Abstract*)

GEORGE J. HILSDORF, S.J.

Carbonyl and thiocarbonyl bis-thiogycollic acids are cheap compounds, easily prepared from Na_2S, CS_2 and $ClCH_2COOH$. Only three esters of these acids are reported in the literature. The preparation and some properties of ten more, up to the amyl and issamyl, were described. The esters of the thio acid are yellow crystalline substances below their melting points, those of the carbonyl acid, white. The melting points differ widely but conform to some weak generalizations about this property. This work is an example of a practical undergraduate group research project.

Mathematics

THE THEORY OF FINITE STRAIN OF AN ELASTIC BODY

(*Abstract*)

PATRICK A. HEELAN, S.J.

This paper is an attempt to discuss the significance of recent developments in the Theory of Finite Strain of an Elastic Body. The nature of the problem is described and some of the difficulties are touched upon. Some new perspectives opened up by these developments, such as the effect of initial strain upon the elastic behavior of a body, and on the nature and number of the so-called "elastic constants", are referred to. Finally, the importance of the consideration of finite strain in seismic problems is stressed and a brief resume is given of the work already done in this field by Birch and Bullen.

LIMITS—SAFER AND SIMPLER

(*Abstract*)

DOMHNALL A. STEELE, S.J.

Taking for granted that rigor in mathematics is the shield of its autonomy, the spring of its fruitfulness, the condition of its beauty and the key to its better teaching, this paper offered one means of attaining it without the incessant clatter of deltas and epsilons.

The definition of *internal* convergence for sequences once ended with $|a_p - a_q| < e$, that of *external* with $|L - a_n| < e$. The former is immanent, the latter presupposes L ready for comparison. External implies internal trivially, internal implies external profoundly—for it leans upon the preconstruction of real number. The modern plan of splitting limits into SEMILIMITS goes back to Gausz in 1800. Let all terms lie between finite barriers. Sharpen Dedekind by means of abstract algebra, then dichotomize the rationals in four ways, attaching to the sequence (a_n) four *always-existent* real numbers in the subjoined manner:

new REAL	each smaller RATIONAL	each larger RATIONAL	name
$\overline{\text{fin}}\ (a_n)$	$\leqslant$ one or more terms	$\leqslant$ not a single term	upper bound
$\overline{\lim}\ (a_n)$	$\leqslant$ unboundedly many terms	$\leqslant$ boundedly many terms	upper semilimit
$\underline{\lim}\ (a_n)$	$\geqslant$ boundedly many terms	$\geqslant$ unboundedly many terms	lower semilimit
$\underline{\text{fin}}\ (a_n)$	$\geqslant$ not a single term	$\geqslant$ one or more terms	lower bound

No calculations, only distinctions between *no* and *one or more*, or *boundedly* and *unboundedly* many, are required to identify the old situation $a_n \to L$ with the new situation: $\underline{\lim}\ (a_n) = \overline{\lim}\ (a_n) = L$. *Convergence* is seen with Gausz to be the case where two semilimits coincide—a rare and accidental event. No calculations, only the same distinctions, are required to establish that

$$\underline{\lim}\,(a_n)+\underline{\lim}\,(b_n) \leqslant \underline{\lim}\,(a_n+b_n) \leqslant \overline{\lim}\,(a_n+b_n) \leqslant \overline{\lim}\,(a_n)+\overline{\lim}\,(b_n).$$

When the first and last meet, the middle two are forced to meet at the same place. The elementary theorem on the limit of a sum is thus the pitiful ruin of a theorem on semilimits which, besides catering for non-convergence too, is actually easier to prove. Similar theorems hold for differences, products, union sets, logarithms and hence powers, arithmetic means, and so forth, each time yielding elementary theorems by compression, and each time catering for non-convergence too.

Ulisse Dini (1845-1918) iterated the process to explore the finer structure of real functions. Fix a and the forward interval $[a, a+h]$. The upper bound of $f(x)$ relative to $a<x<a+h$ depends on h. The lower bound of these upper bounds, relative to $h > 0$, depends only on a. Call it $\overline{f(a+0)}$ and likewise construct $\underline{f(a+0)}$, $\overline{f(a-0)}$, $\underline{f(a-0)}$. *Continuousness* is the case where all four coincide with $f(a)$—a rare and accidental event. But now, a large number of intermediate behaviors is discernible.

Ludwig Scheeffer (1859-1885) applied these demisemilimits to difference quotients and obtained four demisemiderivatives. *Differen-*

tiability is the case where all four coincide—a rare and accidental event. Theorems on derivatives are pitiful ruins of theorems on demi-semiderivatives which, besides catering for non-differentiability too, are actually easier to prove.

The general principle of simplification is here, that whatever exists always is easier to handle than whatever exists only upon conditions.

After flinging the Optimum Salmon Can into the garbage, instructors in analysis can strike out boldly in this and cognate ways. Their difficulty must not be measured as a maximum during the Course, but as an integral over it. Greater early effort pays handsomely. Whatever method needs no patching at any higher level is already best at any lower level, even for students who stay at the lower level: another reason why instructors must know ahead of their matter.

NOTES ON DESCARTES' LA GEOMETRIE

(Abstract)

James J. Fischer, S.J.

An analysis was made of Rene Descartes' claim to the title, the Father of Analytic Geometry. His purpose and method was considered in his solution to the "problem of Pappius" restricted to four non-parallel lines. These were compared to the approach of modern Analytic Geometry texts to determine what exactly Descartes contributed and what was the work of later mathematicians.

A MATHEMATICS COURSE IN A LIBERAL EDUCATIONAL CURRICULUM

(Abstract)

Wallace G. Campbell, S.J.

Mathematics as taught in colleges for many years has been forced into very rigid and exact divisions, apparently satisfactory for those who need Mathematics as a tool for Physics, Chemistry, Biology, etc. However, non-science majors are advised to and should take one year of Mathematics in their liberal educational curriculum. To force these students into the same courses as science majors has resulted in their dislike for Mathematics and what is worse, they are usually terribly confused, know no basis for their scattered knowledge, and cannot logically explain it. These students should have a course composed with special attention paid to the purpose for which they are studying Mathematics. Such a course which has met with considerable success to date, has included an introduction to Mathematical logic, a short treatment of the number system, the essentials of algebra, the algebra of logic, Mathematical induction,

group theory, etc. However, the approach and development of this course has emphasized the logical structure. What is the basis of the particular branch being studied and how is it logically built up? With such an approach, the student knows what he is about and while no branch of Mathematics is developed extensively, enough time is spent so that the student grasps the basis and logical development.

HOMOTOPIC PATHS

(Abstract)

CHARLES J. LEWIS, S.J.

The notion of homotopy, borrowed from Topology, helps to define with analytic precision what is meant by a simply connected region. We first define mutually homotopic paths; then we define a simply connected region in terms of homotopic paths.

1) Definition: Given the region $R<K$ (complex plane); p_1 p_2 paths with common initial and terminal points, a and b respectively, both paths lying in R; then p_1 is said to be homotopic to p_2 in R if and only if there exists the continuous map D from $0\leqslant t,\ t\leqslant 1$ into R satisfying:

$D(O,t) = a$ for $0\leqslant t\leqslant 1$
$D(t,0)$, $0\leqslant t\leqslant 1$ is a representative of p_1
$D(1,t) = b$ for $0\leqslant t\leqslant 1$
$D(t,1)$, $0\leqslant t\leqslant 1$ is a representative of p_2

2) Definition: A region $R<K$ is said to be simply connected: if and only if for all x and y in R, all p in R with initial point x and terminal point y are mutually homotopic in R. Homotopy is an equivalence relation, satisfying the reflexive, symmetric and transitive laws.

Physics

STATISTICAL FLUCTUATIONS IN RADIATION MEASUREMENTS

(Abstract)

JOHN A. TOBIN, S.J.

The random nature of the fundamental processes involved in the emission and detection of nuclear particles requires the use of statistics and the theory of probability. Random fluctuations are

encountered throughout atomic physics as "tube noise" due to the fluctuations of the motions of the electrons in a tube, but it is only in nuclear physics that the individual particles are sufficiently energetic to be individually detectable. The arrival of the "counts" is much the same as the arrival of raindrops on a window pane. The decay of the atom was discussed, and the assumption that the number of atoms disintegrating in a given time interval is proportional to the number of radioactive atoms present was proved to agree with experiments. The constant of proportionality or the number of atoms decaying per unit time divided by the total number and the "half life" as a measure of the rate of decay was explained by examples. A decade counter was registering varying amounts at 30 second intervals and the fluctuations were demonstrated. It is pure chance that individual events take place, so a large number of events, when averaged, shows a clear rate of decay. But the fact remains that the random nature of the individual process underlies the determination by statistics of these constants. Since the fluctuations are inevitable we must be wary of data taken only with a few counts. We must be prepared to accept the limitations imposed on our experiments by the method of counting the particles. And by means of Poisson's formula we can determine the ratio of the number of times a definite count would be recorded to the whole number of trials on the condition that a large number of trials were made. The number observed is assumed to represent the true average, but we have no guarantee that it does. However we can suppose that the count is in error by a certain amount. As a rough guide we can expect a fluctuation as great as the square root of the number of particles counted in one observation. For a one percent relative deviation we must take 10,000 counts. A difficulty arises from the background. Even if no radioactive samples are near the counter, there is a reading on the counter. This background is due to cosmic rays, and radioactive material in the room and contamination in the counter. The method is to measure the sample and background in the counter, and then remove the sample and measure the background. Statistical theory shows that the standard deviation is equal to the square root of the number of counts of sample and background and the number of counts of the background. To obtain a relative deviation of one percent when the background equals that of the sample it was shown by the use of statistics that 60,000 counts had to be taken of the sample, instead of the 10,000 with a zero background. It was noted that condition errors due to spurious counts, coincidence losses, self absorption of the source, and scattering effects are larger than any statistical errors, and it was explained how they were corrected. As many of the measurements are relative, the ratio remains the same and these corrections are not needed. But in absolute measurements great care must be taken to avoid these condition errors as well as to determine the probability of the results.

PHILOSOPHICAL IMPLICATIONS OF PHYSICAL STATISTICS

(*Abstract*)

JOSEPH T. CLARK, S.J.

Since the physical statistics of Maxwell-Boltzmann, Gibbs, Darwin-Fowler, Bose-Einstein, and Fermi-Dirac are all designed to deliver probability predictions concerning observables that are verifiable by measurements, conformable to the statistical theory of errors, this paper (1) reviews briefly the statistical theory of errors, (2) expounds and examines the conventional calculus of probability, (3) reports on the state of the question concerning the disputed definition of probability, (4) depicts and correlates the relevant content of the representative systems of statistical mechanics, (5) compares and contrasts the role of probability in pre-quantum and post-quantum systems, and (6) concludes (i) that since probability is a *methodological* device in the statistics of Maxwell-Boltzmann, Gibbs, and Darwin-Fowler, the success of these systems leaves intact, wherever established, a philosophical world-view that ascribes a universal and inescapable determination of *conventional* type to unit entities in the physical universe, but (ii) because probability is prescribed *in principle* in the statistics of Bose-Einstein and Fermi-Dirac, the success of these methods does not leave intact a *conventional* determinism. Of the two solutions available to this problem, this paper neglects (a) the purely *epistemological* interpretation of Heisenberg's Indeterminacy Principle, and (b) selects the *ontological* version which is provisionally harmonized with tradition in terms of the distinction between *natura* and *individuum* whereby "indeterminacy" is transformed into the quantum analogue of "personality", both of which are basically surds.

SOME APPLICATIONS OF THE FERMI-DIRAC STATISTICS TO ATOMIC AND MOLECULAR PROBLEMS

(*Abstract*)

JOSE B. BONET, S.J.

The Fermi-Thomas equation which, based mainly on the statistical properties of electrons, permits the calculation of atomic charge densities and potentials, is briefly derived. It is then shown how Hund adapted the Fermi-Thomas method to diatomic homonuclear molecules, by introducing new variables and imposing appropriate boundary conditions. It is also shown how, by merely adding a new boundary condition, the Fermi-Thomas equation can be used to investigate the behavior of the atoms in a metal. Finally, Dirac's revision of the Fermi-Thomas method so that it includes exchange effects is discussed and attention is called to the fact that the numeri-

cal results obtainable through this method are, in most cases, valuable only as first approximations.

THE STATISTICS OF THE ELECTROMAGNETIC FIELD

(Abstract)

ROBERT O. BRENNAN, S.J.

The problem of the energy distribution of black body radiation can be treated either by the classical Boltzmann statistics or by the quantum Bose-Einstein statistics. The formula of the energy density in a black body as a function of the frequency of the radiation was first discovered by Planck who set up an equation for d^2U/dS^2 which was an interpolation formula for this quantity as given by the formulae of Rayleigh-Jeans and Wien. The details of this calculation may be found in *Science 113*, 75 (Jan. 26, 1951). Planck was able to interpret his formula statistically as the energy of a system of oscillators in equilibrium if the oscillators were permitted to have only those energies which were integral multiples of a unit of energy proportional to the frequency of each oscillator. The most probable state of the system, derived with the subsidiary conditions that the average energy of the system and the number of oscillators be constant, leads to the correct expression for the energy distribution.

The question arises: what are the oscillators one is discussing here? Two answers may be given. Either we may talk about a fictitious set of oscillators in thermal equilibrium with the black body, or we may conceive the standing waves of the electromagnetic field as a set of oscillators.

The fact that the permitted energy states of each oscillator are integral multiples of a single unit suggests an alternate model of the black body. The unit of energy is attributed to particles of a gas. The integral quantum number is interpreted as giving the number of particles of a given kind present. Such a gas must be treated by Bose-Einstein statistics. One obtains the same equation as before if he determines the most probable distribution with the average energy constant but not now with the number of particles constant, since the particles (photons) may be absorbed and emitted in the black body.

In the *Physical Review 83*, 125 (July 1, 1951) a more satisfactory (though by no means elementary) treatment was proposed which prescinds from either model and simply uses the method of Gibbs (modified by Klein for quantized systems). All that is required is the Hamiltonian of the field derived from the quantum theory of fields.

Planck's derivation of his formula was perfectly in accord with the Bohr quantum theory. Wave mechanics, unfortunately, introduces a second term in the radiation formula. Although this term

is necessary to obtain the correct extrapolation to the classical equations and certainly belongs in the very analogous formulae for the vibrational energy of molecules and solids, it leads here to an infinite total energy for the black body. This term is usually omitted by a redefinition of the zero of energy, but one is not very happy about subtracting infinity.

THE DETERMINATION OF NUCLEAR SPIN AND STATISTICS BY MOLECULAR SPECTROSCOPY

(*Abstract*)

JOSEPH F. MULLIGAN, S.J.

The successful conjunction of quantum mechanical theory and experimental spectroscopic data has been able to throw much light on the properties of nuclei. Two important properties of nuclei are their spins and the type statistics, whether Fermi-Dirac or Bose-Einstein, they obey. Both these properties can be determined from the observed intensity alternation of the rotational lines in the spectra of homonuclear diatomic molecules. Since homonuclear diatomic molecules have no pure rotational spectrum in the infrared, this alternation is observed either in the rotational Raman spectrum, or in the rotational lines of electronic band spectra.

Quantum mechanics has shown that the ratio of the intensities of alternate rotational lines of a homonuclear diatomic molecule is $R = (I + 1)/I$, where I is the nuclear-spin quantum number. Hence from an experimental measurement of R, the nuclear spin can be determined. Also, by determining from the spectrum whether the odd or even-numbered rotational levels have the greater population, it is possible to determine the type statistics obeyed by the nucleus.

As a result of such spectroscopic investigations of intensity alternation, it was found that nuclei with even mass numbers have integral spin and obey Bose-Einstein statistics, whereas nuclei with odd mass numbers have half-integral spin and obey Fermi-Dirac statistics. This led to the rejection of the old picture of an atomic nucleus made up of protons and electrons, and the acceptance of the present picture of a nucleus made up of protons and neutrons, each of spin ½ and obeying Fermi-Dirac statistics. The total nuclear spin is then the vector sum of the spins of the individual nucleons, and the type statistics a nucleus obeys depends on whether an odd or even number of elementary particles (protons and neutrons) is present.

QUANTUM MECHANICS AND THE THEORY OF NUCLEAR FORCES

(Abstract)

WILLIAM G. GUINDON, S.J.

Because of the increasing difficulty of keeping in touch with Modern Physics, especially Nuclear Physics, this paper attempts to give a unifying viewpoint; it is not intended to be a survey of current work.

There is a real, if not explicit, unity to Nuclear Physics, both experimental and theoretical. The nature of the force, still imperfectly known, between nucleons (neutrons and/or protons) is the fundamental problem, linking work on bombardments, radioactivity, transmutations, cosmic rays, and nuclear structure.

Quantum Mechanics has had phenomenal success in explaining atomic data, yet it is only an approximation. This is due not merely to the errors of experiments, but to the lack of mathematical techniques and of correct theoretical formulation of many of the problems. And this is true even in the atomic field where the basic law of force is well known in advance: the Coulomb interaction between charged particles.

In Nuclear Physics, where the basic force is but sketchily determined, the situation is much worse, as is seen in the current difficulties of meson physics, theories of radioactivity, and nuclear structure discussions.

In view of these difficulties, it is helpful to keep in mind, first, the centrality of the problem of nuclear forces, and, second, the assumption, perhaps not necessary, of the applicability of Quantum Mechanics to Nuclear Physics. Nuclear Physics awaits a genius who can unite the divers subdivisions in a simple theory.

THE MEASUREMENT OF VACUUM PRESSURES BY THE STUDY OF ADSORPTION OF GASES ON TUNGSTEN

(Abstract)

JAMES J. RUDDICK, S.J.
St. Louis University

This paper is a brief review of the development of a method of measuring vacuum pressures by the study of the adsorption of gas on the surface of tungsten. Although at present the method is still unsatisfactory, recent developments indicate that the study of experimental plots of the gas adsorbed on the surface as a function of the time of deposition may prove of value. The value of the sticking coefficient for various gases and pressures is of special interest.

COLORS OF TWENTY-FOUR CEPHEIDS IN THE CRUX-CARINA REGION

(*Abstract*)

MARTIN F. MCCARTHY, S.J.

During the past four years, work on the problem of space absorption in a region of the southern Milky Way has been in progress at Georgetown College Observatory. The method employed in this work has been an analysis of the colors of twenty-four Cepheid variable stars which are situated in this very rich region of our galaxy.

The history of the development of this method of estimating the extent and effect of space reddening and an account of the different statistical relations employed were set forth briefly.

A series of fifteen slides was presented which showed the location of the Georgetown Cameras at Bocaiuva, Brazil, the Milky Way starfields in the constellations of Crux and Carina, the observed light and color curves of the Cepheids, the derivation of absorption and distance data for these stars, and finally the relation of our conclusions to those derived in earlier investigations made in this part of the sky.

The present investigator will always be grateful for the careful guidance and generous assistance received from Father Francis J. Heyden, S.J., and for the excellent plate material provided for this research by Father Heyden and Father L. C. McHugh, S.J., of Georgetown.

CURRICULUM PROBLEMS IN A FIVE YEAR COOPERATIVE MAJOR IN ELECTRONIC PHYSICS

(*Abstract*)

JOHN S. O'CONOR, S.J.

Saint Joseph's College of Philadelphia is offering a program in Electronics which is believed to be somewhat of a unique departure for a liberal arts College. Beginning September 1951 the Physics Department is instituting a five year cooperative curriculum leading to a Bachelor of Science degree in Electronic Physics. Freshman and sophomore years in this option are the same as for those majoring in pure physics. Through agreements with five of the major electrical and electronic industries in the Philadelphia area, pre-junior students, who qualify, spend alternate three month periods in the plants of the cooperating industries. This exchange between academic and industrial work continues for twelve quarters until graduation. Details of the curriculum were read and discussed.

FATHER SECCHI AND SOLAR RESEARCH

(Abstract)

VICENTE MARASIGAN, S.J.

The paper summarizes Fr. Secchi's works on sunspots, solar radiation and prominences. It includes a condensed account of his eclipse expeditions in Spain in 1860, together with the conclusions he deduced from his observations. Also given is a brief sketch of his initial attempts in the field of solar spectroscopy. Finally, the author gives his view of how Fr. Secchi stood in relation to the scientific climate of his time.

A HIGH SCHOOL COURSE IN PHYSICS

(Abstract)

SIGMUND J. LASCHENSKI, S.J.

An outline of a complete high school course in physics as taught to a class of seniors in one of our Jesuit secondary schools during the school year of 1950-51, was presented in this paper. The topics treated were: I. The Aims of a high school physics course; II. The Content of the course; III. The Method of teaching the course; IV. Basic and Supplementary Material employed; V. The Laboratory, the experiments given and the methods followed; VI. An Evaluation of the course by the author of the paper, and a request for criticism from the audience. A lively discussion followed the delivery of the paper with an enlightening exchange of ideas on the subject.

VISUAL AIDS IN HIGH SCHOOL PHYSICS

(Abstract)

FRANCIS R. CARMODY, S.J.

Various free government films, as well as films produced by large business concerns, which are useful in explaining concepts of High School Physics, were mentioned, and the method of obtaining these films was indicated. Many free and low cost materials such as charts, booklets, brochures, etc., which can be had from the same companies in sufficient quantities for classroom use and distribution were also mentioned. The program closed with a showing of two U. S. Navy films, sc., "Naval Photography in Science" and "Operation Crossroads".