S.J.B

A. M. D. G.

American Association of Jesuit Scientists

Eastern States Division

PROCEEDINGS

of the

Seventeenth Annual Meeting

August 15, 16 and 17, 1938

Holy Cross College, Worcester, Mass.

Published at

LOYOLA COLLEGE

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PRESIDENTIAL ADDRESS

Mathematics and Its Applications

REV. GEORGE A. O'DONNELL, S. J.

What is Mathematics and to what role should we assign it in our present scheme of education and in our modern world? To answer these questions correctly we should require many vast tomes. The place that Mathematics should occupy in an educational program and in our modern world, should be determined from the standpoint of the objectives which we wish to attain in our present scheme of things. Hence, it will be to our advantage to consider the help that Mathematics has given us in the past, the assistance it is giving us now and the profit which we expect to derive from it in the future.

So old and familiar are some of the uses of Mathematics, almost second nature to us at present, that we are in danger of neglecting them and passing them over in silence. Furthermore, so many and so varied are some of the applications of modern mathematics that very few, save those making use of these applications, know of them, and hence those not making use of these applications and even many teachers of mathematics are ignorant of these newer applications.

Before going into the applications of Mathematics, it might be well for us to recall the two great divisions of mathematics, Pure Mathematics and Applied Mathematics. Pure Mathematics, as Gauss, the Prince of Mathematicians, has styled it, is the Queen of the Sciences. Its advances along various paths have been so great that little, if any, application has been found for it to date. However if we read aright the lesson of the History of Mathematics, we may safely state that our present explorations into these advanced fields will some day come into their own in their applications in our every day life. We might even compare the progress of Pure Mathematics and Applied Mathematics to the game of Hare and Hounds, so far ahead is Pure Mathematics of any application in many instances.

In our every day life we cannot get along without, at least, the elementary notions of Mathematics. The knowledge of arithmetic is constantly being called on in a thousand and one ways. Algebra, too, finds every day applications, for instance, in investments, buying on the installment plan, and statistical methods. Industry, too, has found many applications that we might recount. To give but a single example, we might cite the principles of maxima and minima with which we have all been familiar from our early days in Calculus class. The applications of these principles are so numerous that we could not begin to enumerate them and so familiar to us that we are apt to pass them over in silence.

Mathematics has been called the "Tool of Modern Science." We would make a grave mistake were we to limit the meaning of science in this definition to the natural sciences. Today the biological as well as the social sciences are making great strides owing to their use of Mathematics. Consequently let us pass in review the various applications of Mathematics in some of the fields of Science.

To start to list the applications of Mathematics in the domain of Physics would be simply appalling. In fact, without Mathematics, we might safely say that Physics would be merely descriptive. The uses of the function concept, the derivatives, and the process of summation or integration have caused vast strides to be made in Physics. Advanced Physics today is predominatly methematical in character and every branch of Mathematics finds application in some part of Physics. The introduction of the Theory of Relativity has brought about new developments, bringing the absolute differential calculus, the transformation of quadratic differential forms, and many others, in daily use. The rise of quantum mechanics and wave mechanics has made newer demands on the mathematicians. Matrices here have reached the high water mark of their applications to date; we deal with matrices of infinite order whose elements are imaginary exponentials which the wave mechanic proceeds to expand and these exponentials correspond to the osciilations. Analysis situs, that branch of Mathematics which treats of the properties of figures invariant under deformation, comes to the fore, for example, in the discussion of orbits. A new branch of Physics in late years is Statistical Mechanics which finds extensive use in both Physics and Chemistry. We might go on indefinitely citing the importance of the applications of Mathematics in Physics, but, as our time is limited, we must pass on to other fields.

We next find ourselves in the field of Chemistry. Formerly it was thought that ratio and proportion and elementary arithmetic sufficed for the chemist. Yet today almost all chemical phenomena are being interpreted in terms of physical chemistry and physical chemistry cannot be mastered without a thorough mathematical foundation extending beyond the calculus and differential equations. Reactions rates, absorption of light, the cooling of heated bodies, and many other problems call for a thorough mastery of exponentials and calculus. Chemical thermodynamics consists in great part of the use of partial derivatives and partial differential equations; in its problems as many as ten different factors may be involved: pressure, temperature, volume, entropy, heat, work, internal energy, heat content, free energy, and thermodynamic potential. The theory of groups finds a wide application in the study of organic compounds. By applying the principle of groups to relations between carbon and other atoms new possibilities have been opened up in organic chemistry. Physical chemistry constantly calls on differential equations, empirical equations, the theory of errors in experimental measurements, and allied topics. Work on crystals and crystal refraction will lead to the employment of elliptic integrals. Graphs and graphical calculations, too, are coming to the fore. In many instances so many factors may be involved that all hope is lost of finding a theoretical equation or functional relation connecting the variables, yet from one simple graph many other properties may be calculated with an accuracy that will depend only on the precision of the graphical method.

We next turn our gaze to the field of the geological sciences. Here, too, the applications of Mathematics are many. Physiography and Cartography demand a thorough knowledge of trigonometry, analytic geometry and calculus. Field Geology and geological mapping call upon the mathematical principles of surveying. Problems of the origin and the age of the earth look to the mathematical theory of heat production, the geothermal gradient and the mathematics of radioactive substances. The location of ore bodies has opened up the vast fields of geophysical prospecting which involves mathematics of a very advanced order, in its magnetic, electromagnetic and seismic methods. Geophysics concerns itself with such questions as: the thermal history of the earth's surface and interior, land and sea tides and their frictional effect on land masses, the theory of isostasy and its applications to surface features, the hydrodynamics of surface and subsurface waters, the mechanics of plastic flow and elastic deformation. Modern seismology with its earthquake determinations, the theory of propagation of elastic waves and wave paths through the earth, and the internal constitution of the earth, demands a thorough grounding in the advanced treatises of integral equations, the mathematical theory of elasticity, the theory of series and many other topics.

Now let us turn to the biological sciences. Here we might expect that there would be a few applications of mathematics, inasmuch as the biological sciences deal with phenomena that are the most complex of natural phenomena and hence not capable of mathematical treatment. This is due to the fact that the internal structure and functioning of various organisms and the multifold effects of heredity and environment produces complexities that are utterly foreign to Physics and Chemistry where one deals with molecules of less complex materials and under more controlled conditions.

There are at present two great fronts along which Mathematics has come into the field of Biology, first through the influence of Physics and Chemistry, and secondly through Biometry. As the science of Biology progressed it was but natural that one would interpret biological phenomena in terms of physical and chemical phenomena. The study of physics and chemistry of life processes has led to great progress in the exactness of experimental conditions, in the precision of measurements taken, and the analysis of these measurements by mathematical methods which alone are capable of dealing with quantitatively measured variables. This led to the great development of Biophysics and Biochemistry which today are almost independent sciences. Thus, for example, the production of lactic acid by bacteria and the rates of digestion involve the use of differential equations; the healing of wounds and metabolism involve irrational algebraic functions, to give but a few of the many problems. Along this front, the physico-chemical front, the advance of Mathematics into Biology has been indirect.

But this situation is entirely reversed when we come to the second great front, Biometry. This work, developed by Galton and Pearson, pointed the way to the mathematical treatment of a vast group of problems and the analysis of the highly variable data of biological observation and measurement. This was brought about chiefly through the use of statistical analysis, for statistics is that branch of mathematics which, based on the theory of probability, serves to help an observer interpret the evidence obtained from his observations and to act as a guide in the accumulation of observations. Here is wide scope for the various statistical methods including the description of various types and the formulae for standard deviation from these types, the theory of sampling, the various frequency distributions and frequency curves, the problems of correlation together with the correlation coefficient and ratio, linear and non-linear regression equations, intra-class correlation theory, and the rigorous mathematical testing for agreement between the empirical and theoretical distributions.

When we turn to the field of the social sciences we find a great variety of applications of statistical analysis, as well as of non-statistical mathematics. Among the social sciences we find perhaps the greatest need for Mathematics in the field of economics. The use of Mathematics in this field may be traced directly to a work by Cournot, published in 1838, and entitled, "Recherches sur les principes mathematiques de la theorie des richesses."

The subject of economics may be divided into two great divisions, static and dynamic economies. The former treats of static equilibrium, curves of supply and demand, utility potentials, theories of production, etc.; the latter deals with the behavior of time series, the questions of cycles and trends, crises, and the growth of population and productive enterprises.

In static economics we find a remarkably close analogy with the science of mechanics and hence the mathematical tools used in mechanics immediately find their use extended to economics. Thus we have as corresponding elements in both fields: a particle and an individual, force and marginal utility, work and disutility, energy and utility, equilibrium of forces and equilibrium of forces and equilibrium of utility, and many others. Here, then, we find plenty of scope for the calculus, differential equations, series, etc. In addition to these we find great use for logarithms, graphs, equations and forms of curves, especially the conic sections, trigonometric and logarithmic curves, the principles of curve fitting, correlation, interpolation, and the theory of probability. In this way there have been developed complicated mathematical theories, such as the mathematics of taxation and the mathematics of finance and investment. Even four dimensional and n-dimensional geometry may be of service here. For example, in the relations between prices and commodities: in the case of a single commodity by plotting the price against the quantity, we may have a declining demand curve and a rising supply or marginal cost curve. The coordinates of the point of intersection of these two curves represent the actual price and quantity attained as a result of the market operation. If the question of taxes is brought in there results an upward translation of the marginal cost curve. Various conclusions are readily drawn from these curves which may be easily represented on the blackboard. However, if we have to deal with two prices and commodities, we have to go into four dimensional geometry. Instead of supply and demand curves we have supply and demand surfaces which we wish to have intersect, not in a curve, but in a point, and in general two surfaces will intersect in a point only in four dimensional geometry. Thus we can readily see that if we wish to deal with more prices and commodities, we shall require more dimensions in our geometry.

When we turn to dynamic economics we find ourselves dealing with differential equations, integral equations, functional equations, the theory of time series, and other topics of advance mathematics.

In the other fields of the social sciences we find an increasing demand for the theory of statistics, curve fitting, correlation, and probability. In Education, too, statistics is beginning to play a more prominent role. The experimental psychologist looks to the mathematician for aid in the questions of stimuli, problems of vision, and psychophysics.

As we look over the various fields of science today we find an increasing appreciation and a wider application for Mathematics. Perhaps the day is not far distant when in our science conventions we shall include in our programs symposia wherein we shall treat in greater detail than was possible in this short paper the development of mathematical methods for these various fields of science.

Formerly in the days of Gauss, Mathematics was proud of its title, the Queen of the Sciences. Today, although still meriting this title, Mathematics bears an even prouder title. In our early days in

Philosophy we met with a descriptive definition, Philosophia est ancilla Theologiae; so too, we might well paraphrase this definition and state, Mathesis est ancilla Scientiarum. Bearing this in mind, we can find no nobler title for Mathematics than this: Mathematics is the handmaiden of the Sciences.

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FIRST GENERAL SESSION

The 17th Annual Meeting of the American Association of Jesuit Scientists, Eastern States Division, was held at Holy Cross College, Worcester, Mass., on August 15, 16, and 17, 1938. The first general session was held on August 15th, at 7:15 P. M. in Alumni Hall, The Rev. George O'Donnell, S.J., presiding. The meeting opened with prayer followed by the welcoming address which was given by Father O'Callahan in the absence of the Reverend President of Holy Cross College. The reading of the minutes was omitted since they had already been published on the Bulletin. Father O'Donnell named the following committees:

Committee on Resolutions

Rev. J. M. Kelly
Rev. J. T. O'Callahan
Rev. E. C. Dubois

Committee on Nominations

Rev. C. A. Berger
Rev. J. P. Delaney
Rev. H. M. Brock

Father O'Donnell then delivered the presidential address. Father Assmuth suggested that a complete bibliography be appended to the article to be published in the Bulletin. The meeting adjourned after prayer.

FINAL GENERAL SESSION

The final session was held in Alumni Hall on August 17th at 11:00 A. M.

The secretaries of the various sections reported the results of the elections as follows:

Biology

Chairman: Father Harold F. Freatman, St. Joseph's College
Secretary: Mr. M. P. Walsh, Weston College

Chemistry

Chairman: Father Joseph Sullivan, Holy Cross College
Secretary: Mr. J. J. Brady, St. Joseph's College

Mathematics

Chairman: Father Thomas J. Love, Georgetown University
Secretary: Mr. Robert F. MacDonnell, Boston College

Physics

Chairman: Father T. J. Smith, Weston College
Secretary: Mr. R. B. Winslow, Loyola College

Fr. Kelly read the following resolutions which were accepted after a motion by Father Berger which was seconded by Mr. McCauley.

RESOLUTIONS

Be it resolved, that the American Association of Jesuit Scientists (Eastern States Division) express its appreciation and gratitude to Rev. Father Rector and Father Minister of Holy Cross College, for their cordial reception and for the gracious hospitality shown to it during its convention.

Be it resolved, that we express our appreciation to the President of the Association for the labor entailed in making this meeting a success, and to Father Francis W. Power for his generosity in carrying the burden of financial direction.

Be it resolved, that we send to Father Richard B. Schmitt, a note of sympathy for his illness, and of thanks for his faithful work as editor of the Bulletin.

Father Power then presented an informal report for the committee appointed last year to investigate the possibility of an exhibit at the World's Fair. The necessity of having several Jesuits constantly in attendance for a long period made the proposed exhibit impractical.

Father Power then presented the Treasurer's report:

Received	$564.00
Paid out	500.26
Balance	$ 63.74

The report was accepted after a motion by Father Love which was seconded by Father O'Callahan. Father was then reappointed Treasurer.

The Committee on Nominations then reported the following nominees:

President: Father Kolkmeyer
Father J. P. Smith

Secretary: Mr. Deeley
Mr. Barrett

Father Kolkmeyer and Mr. Deeley were elected. A motion was made by Father T. J. Smith and seconded by Father Love to give the retiring officers a vote of thanks. The meeting adjourned at 12:05.

EXECUTIVE MEETING

The Executive Committee met on Tuesday evening at 7:30. The candidates for membership in the Association were approved. Mr. R. Eric O'Connor was appointed Canadian correspondent. Father Schmitt was reappointed Editor of the Bulletin. It was recommended that the membership list be revised. It was also recommended that papers of the scholastics be approved by the heads of the department in which they might be working and that the first general meeting be held on the evening of the 16th of August instead of the 15th as in previous years.

MEMBERS ATTENDING THE CONVENTION

Father Assmuth	Mr. Acker
Berger	Ball
Brock	Barrett
Coniff	Brady
Dubois	Burns
Guicheteau	Carroll
Hohman	Dailey
Kelley	Deeley
Kolkmeyer	Devlin
Landrey	Donahue
MacCormack	Eiardi
Murray	Hennessey
McGuinn	Kirsch
Muenzen	Langguth
O'Callahan	McCauley
O'Conor	McCarthy

Father O'Donnell	Mr. MacDonnell
Power	Mulcahey
Shaffrey	O'Connor
J. P. Smith	Ring
T. J. Smith	Thiry
Schon	Walsh
Sullivan	

NEW MEMBERS

Mr. Edward I. Acker, Canisius High School
Mr. John J. Brady, St. Joseph's College
Mr. Joseph A. Cawley, Loyola College
Mr. Frank J. Dailey, Georgetown University
Mr. Edward H. Dineen, Georgetown University
Mr. F. J. Donahue, Holy Cross College
Mr. John F. Fay, St. Joseph's College High School
Mr. Raymond Gough, Georgetown University
Mr. Louis J. Kleff, St. Joseph's College
Mr. John J. McCarthy, Boston College
Mr. John J. Mulcahey, Boston College High School
Mr. Charles M. Neuner, Georgetown University
Mr. R. Eric O'Connor, Weston College

BIOLOGY

ARE THERE TRUE HERMAPHRODITES AMONG INSECTS?

(Abstract)

REV. JOSEPH ASSMUTH, S. J.

True Hermaphrodites are animals which have functional male as well as female gonads in the same individual, in other words: the same individual produces both spermatozoa and ova; such animals are therefore called bisexual. With regard to Insects the statement generally found in textbooks is: they are unisexual. Thus Borradale and Potts in The Invertebrata, p. 446: "The sexes of insects are separate". Folsom and Wardle in Entomology, p. 148: "The sexes are always separate in insects, hermaphroditism occurring only as an abnormal condition".

It is now an established fact that a whole group of Insects is truly—not abnormally—hermaphroditic viz., the family *Termitoxeniidae* of the order Diptera. The first to recognize this phenomenon was Father Wasmann, S.J. He published a paper in 1900 in which he called the *Termitoxeniidae*—we now know, rightly so—protandric hermaphrodites, meaning that the male gonads are first fully developed in an individual, the female gonads following later on. Wasmann's explanation of what he had observed in the few specimens then at his disposal was called in question by zoologists in general and entomologists in particular.

An attempt to substantiate Wasmann's views was made by me in a paper published 1913 dealing in extenso with the anatomy and histology of *Termitoxenia* (now called *Clitelloxenia*) *assmuthi* which I had discovered in British India. But this paper did not end the controversy. Though many entomologists (v.g. Deegener, Carpenter, etc.) accepted, others rejected Wasmann's theory either doubting (Comstock, Imms) or flatly denying (Bugnion, Brues of Harvard) the hermaphroditism of *Termitoxeniidae*. Their main objection was: Although all thus far observed specimens of these Diptera, even the not yet completely developed (the so-called stenogastric forms) contained spermatozoa as well as ova, and though never in spite of most careful investigation a male had been found, yet it was not impossible that males existed and that consequently the investigated individuals were simply fecundated females.

The question is now definitely settled through the painstaking efforts of Dr. C. Franssen in Buitenzorg, Java. After many failures he succeeded in rearing a couple of these flies from eggs each of which had been kept completely separated from the others. As soon as the flies had emerged they were killed and fixed. The specimens when finally (1935) examined by Mergelsberg revealed ripe spermatozoa together with not yet quite mature ova. Now since any mating of these singly bred *Termitoxeniidae* was absolutely excluded it is clear that both kinds of germ cells were produced in the same individual, the spermatozoa before the ova.

Wasmann, therefore, was right in stating: *Termitoxeniidae* are true hermaphrodites.

THE CYTOGENETICS OF DROSOPHILA PSEUDOOBSCURA

(Abstract)

REV. CHARLES A. BERGER, S. J.

Strains of *D. pseudoobscura* were collected from a number of different localities throughout its range—Mexico to Canada west of the Rocky mountains. The species was found to consist of two races, A & B, morphologically identical but separated by a barrier of hybrid sterility. Salivary gland chromosome analysis of strains from different localities showed that each race consisted of strains differing in chromosome structure. In the third chromosome of Race A 17 different chromosome arrangements were found; in the same chromosome of Race B there were five different arrangements. Hybrids between these strains show that the structural differences are inversions. By means of overlapping inversions some idea of the historical sequence of the different strains of this species may be obtained.

THE MACROPHAGES AND THEIR ROLE IN PATHOLOGICAL PROCESSES

(Abstract)

REV. CLARENCE E. SHAFFREY, S. J.

The macrophages are very large phagocytic cells which may be fixed or wandering. They have been given different names by various investigators. They have the property of storing particulate matter and can be best demonstrated by supravital injection of India ink or aniline dyes in colloidal solution.

The fixed ones show no amoeboid movement but the free ones are quite active in putting pseudopodia in search of what may be seized.

These cells are formed principally in the bone marrow, lymph glands, spleen, perivascular tissues of terminal blood vessels, and occur also as the Kupfer cells of the liver.

These cells are the scavenger cells of inflammation, the epitheloid cells of tuberculosis and syphilis, the large cells which form a zone around a chronic abscess. They appear in peritonitis, pleurisy and meningitis, taking their origin from the histiocytes of the serous membranes. They are also the large phagocytic cells of typhoid fever which are found in abundance in the red marrow, Peyer's patches, solitary follicles and lymph nodes and in the spleen where they crowd the sinuses, hindering the outflow of the blood and giving the organ a deep red color due to the congestion.

The capacity of the macrophages to store lipoids is seen in Gaucher's disease, Niemann-Picks disease and in Christian's disease.

In Hodgkins' disease the entire reticulo-endothelial system is involved at the same time, there being a general enlargement of all the lymph glands of the body, the liver, spleen and hyperplasia of the bone marrow accompanied by a very great increase in the macrophages in these organs.

The macrophages are the main, if not the only source of the antibodies in infectious diseases. This is shown by the temporary cessation of immunity when the reticulo-endothelial system is blocked by supravital staining. They also remove bacteria from the blood and store them in large clumps in the organs which are the source of the phagocytes.

GROWTH HORMONES IN PLANTS

(Abstract)

Michael P. Walsh, S. J.

This paper is a review of the brief history of plant hormones. The economic importance of the subject was presented through an account of the effects of these substances on root formation, fruits, and chromosomes. Included as growth promoting substances are "all those substances which by other than nutritive means, directly or indirectly initiate, accelerate, or inhibit (1) the growth, development, or reproduction of unicellular and multicellular individuals, and (2) the relatively irreversible increase in dimension, number, and kind of parts of these individuals." The early work of Darwin, Boysen

Jensen, and Paal was reviewed as well as such topics as the formation and occurrence of auxins in plants, their chemistry, and transport. Over fifty chemicals are now known to produce such responses as cell elongation, cell inhibition, cambial growth, root formation, parthenocarpy, and tropisms.

Synthetic hormones and especially the commercial product, Hormodin were discussed. Experiments with Hormodin were suggested for Botany classes, as demonstrations of absorption and translocation, local acceleration of growth, and root formation in plants. The paper ended with a discussion of the unsolved problems and future research.

THE STELLATE CELLS OF von KUPFFER

(Abstract)

GERALD J. HENNESSEY, S. J.

The stellate cells are scattered star-shaped cells found in the hepatic sinusoids. They project slightly into the lumen of the sinusoid and readily phagocytose foreign substances. In appearance they are large ovoid cells with a large clear nucleus, a rather prominent nucleolus and a cytoplasm that is stretched out into many fine processes and almost invariably shows a large amount of stored inclusions. They exhibit a marked avidity for particulate matter such as India ink and the basic aniline dyes.

Their origin is still in dispute. There is some evidence that they arise from a reticular source but the preponderance of authority and experimentation seems to favor an endothelial origin. Both metabolic and defensive functions have been observed in the von Kupffer cells. In diseased conditions their phagcytic character may be increased or lessened. After von Kupffer cells have broken from the wall of the sinusoid and transformed to free histiocytes in the blood they migrate to the lungs, spleen, or are devoured by other macrophages. Their dissolution however, is still in the hypothetical stage and requires more work.

The reason for all the perplexities and theorizing concerning the von Kupffer cells is undoubtedly due to their dual nature. Because of this they have been placed in the reticulo-endothelial system. But although they have much in common with other wandering cells they have more striking differences. The reticulo-endothelial system does not answer the problem, it merely broadens it.

CHEMISTRY

GLASS BLOWING IN CHEMISTRY

(Abstract)

Rev. Joseph J. Sullivan, S. J.

This paper dealt with some of the everyday problems met in the Chemistry Laboratory and served as a sort of prelection to a demonstration given by a professional glass-blower in the evening. Problems briefly considered were: preparation of the glass for some operation, as cleaning and cutting the glass and smoothing rough edges, also shaping the glass, as in making seals, bends and bulbs. Proficiency in manipulating glass in the blow-pipe is had first, by watching someone who knows, secondly by long practice. Perfect balance of the hot glass must be maintained, if a smooth job is to be accomplished. The glass-blowers tools were then displayed, such as burners, flaring forceps, tapered carbon rods, snap-rings, etc. Some samples of glass-blowing prepared by the author during this past Summer were shown. Also some references to monographs on glass-blowing which might prove helpful. It appears from the author's experience that proficiency in this art not only helps the laboratory instructor to solve many problems in the set-up of apparatus, particularly in organic and physical chemistry, but also stimulates the students to acquire this facility themselves. And, it is a known fact that if a man can append to his qualifications: "I can also do some glass-blowing", he has a strong chance of being considered favorably when applying for a position in Chemistry

THE USE OF ORGANIC REAGENTS IN ANALYTIC WORK

(Abstract)

Edward I. Acker, S. J.

The reasons for turning to the organic field for reagents by means of which inorganic substances may be detected may be briefly summarized:

1) Organic substances frequently form very insoluble bodies when combined with inorganic substances;

2) Insolubility in certain cases depends on the size of the molecule, more readily variable in the organic field than in the inorganic;

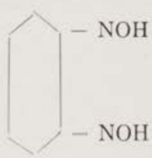
3) Numerous inorganic-organic compounds are colored, hence more visible to the eye;

4) Color as well as solubility may be regulated readily in the organic system by governing the constitution of the molecule;

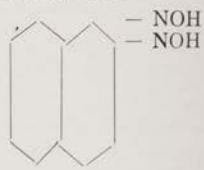
5) Coloration and insolubility make it possible to detect and determine amounts of substances which were absolutely impossible of previous detection.

At the present time the micro-analyst must depend on the following groupings for specificity:

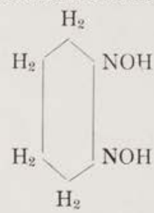
1) R − C = NOH
   R − C = NOH for Ni^{++}. It is interesting to note that



and



do not give precipitation with Ni^{++} only, but give brown or yellow precipitates with almost all metals. Property returns with cyclohexanone dioxime —



2) R : C(OH)−C(=NOH)−R, where : C(OH)− is derived from analizable : C−O precipitate, is specific for Fe^{++}. Thus isonitroso acetylacetone is specific for Fe^{++} in 0.0075 % solution.

3) R−C(=O)−CH_2−C(=O)−R′ specific for Ti^{+++} in presence of CS_2, depending on enolization;

H

4) R–C–C–R′ specific for Cu^{++} giving green salts. In this case when R and R′ are aryl groupings coordination occurs with the formation of compounds insoluble in NH_4OH;

OH NOH

5) Hydroxyanthroquinones lead to lakes in Al^{+++}, Zn^{++++}, and F^{-}.

6) –NH is specific for Ag^{+}, and is very good for Hg^{++}. Rhodamine, as p–di Me amino benzylidene rhodamine is particularly excellent for Ag^{+}.

FUNDAMENTALS OF THERMODYNAMICS

(Abstract)

LEO J. GUAY, S. J.

This paper brought to the attention of teachers of thermodynamics an article, "A Presentation of the Fundamentals of Thermodynamics", by W. E. Roseveare, [J. C. E., 15, (1938)] wherein Mr. Roseveare gives to thermodynamic quantities names literally defining them, and from these definitions and the fundamental laws of thermodynamics develops the fundamental relationships between the different forms of energy. Using the same definitions, Mr. Guay proceeded to develop the notions of entropy, isothermally available energy or free energy, and isothermally available energy or maximum work, as criteria of equilibrium and spontaneous change.

MATHEMATICS

NEWTONIAN RELATIVITY

(Abstract)

Rev. Joseph T. O'Callahan, S. J.

In this paper it was shown that the adequate treatment of uniform motion, even according to the principles of Newtonian physics, demands a non-Euclidean geometry. The reason is that the Newtonian principle of absolute simultaniety implies geometrically that there is one fixed line in the plane of rotation of the rest axes, and this is impossible in a Euslidean rotation. It was further shown that the proper non-Euclidean geometry for Newtonian motion is a special limiting case of that used by Einstein in his special theory of relativity, in which the two invariant lines of Einstein are squeezed into coincidence and become the one invariant line of absolute simultaneity, perpendicular to any and every rest axis.

DIFFERENTIAL EQUATIONS OF GEODETICS IN TENSOR NOTATION

Harry W. Ball, S. J.

(Abstract)

Employing the methods of the Calculus of Variations the differential equations

$$\frac{d}{dt}\left(\frac{\delta\Phi}{\delta x^1}\right) - \frac{\delta\Phi}{\delta x^1} = 0$$

are determined as a necessary and sufficient condition that the variation in the integral of a curve equal zero. These equations are known as the Euler equations of condition.

After applying the tenor notation and reducing the resulting differential equations we have:

$$\frac{d^2x^1}{ds^2} + \Gamma^{e}_{jk}\,\frac{dx^j}{ds}\,\frac{dx^k}{ds} = 0$$

where Γ^{e}_{jx} is a Christoffel symbol of the second kind.

THEORY OF GROUPS WITH APPLICATIONS IN PHYSICS AND CHEMISTRY

(Abstract)

R. ERIC O'CONNOR, S. J.

The great importance of group theory in mathematics is due to the fact that the definition of group isolates in their logical causes the phenomena of invariance, symmetry, the fundamental similarity of many mathematical entities like the integers, the rational numbers, matrices, sets of transformations, etc., and other phenomena of mathematics that were not here considered.

Illustrations were given of these three things and their connections with groups; of invariance, by a simple proof and generalization of the theorem of Pythagoras and by an indication of the influence of the notion of invariance in the development of the theory of relativity; of symmetry, by a consideration of the symmetries of plane figures, if crystals, etc. The advantage of knowing that a set of mathematical entities form a group is exemplified by a proof of Fermat's minor theorem: "If p is a prime integer and a is any integer not divisible by p, then p is an exact divisor of $(a^{p-1}-1)$."

NOTES ON GROUP THEORY

The following definitions and examples will be of use to those unacquainted with the notion of group. They may be found in any text on group theory.

Definition of a Group. A set of elements a, b, c, . . . which combine by an operation (indicated by a period and called "product") is a group if the following postulates are verified:—

1) The product of any two elements is also an element, i.e.

$$a.\,b = c$$

2) The associative law is fulfilled, i. e.

$$(a,\,b).\,c = a.\,(b.\,c)$$

3) In the set is an element e — the "unit" — such that for every element a, $e.a = a.e = e$

4) If a is any element, there is also an inverse element a^{-1} such that $a^{-1}.\,a = a.a^{-1} = e$

Remarks. It is not assumed that $a.b = b.a$. If however this condition is fulfilled for every pair of elements, the group is said to be "*commutative*" or "*abelian*". The set of elements maye be finite the number of elements is called the "order" of the group.

Examples of Groups. The set of integers (including zero and negative integers) with the operation of *addition*. Clearly all the postulates are fulfilled, the "unit" is zero, and the inverse of a is -a. This group is abelian and of infinte order. (Note that this same set of integers, with the operation of *multiplication* does *not* form a group; for the unit would have to be 1 and then neither zero nor any integer other than 1 would have an inverse.)

The set of rational numbers (proper and improper fractions), excluding zero, form a group with the operation of multiplication. Here the unit is 1, the inverse of a is 1/a, and again the group is abelian and of infinite order.

If we choose some prime number, say 7, and postulate that all integers with same remainder when divided by 7 are the same as far as we are concerned (thus—5, 2, 9, 16, . . . are all the same as 2 and —2, 5, 12, 19 are all = 5) then we easily find that the six elements

$$1, 2, 3, 4, 5, 6$$

with the operation of multiplication (e.g. 3.4 = 5, 2.5 = 3, etc.) form an abelian group of order 6.

The set of all possible *changes* of rectangular coordinates in the plane form a group if the operation for combining them is defined as follows: a.b is the *single change* c which is equivalent to the successive changes, b followed by a. This group is of infinite order and *non-abelian*.

Limiting ourselves to those elements of the preceding group which leave the origin fixed, we have a group, contained in the preceding (and hence called a sub-group of it). This sub group is abelian since a rotation of 20° followed by one of 35° is equivalent to a rotation of 35° followed by one of 20°, the sense of rotation being the same.

Remark. A more important idea in Geometry than that of coordinate change is that of "*transformation*". Here there is question of giving a rule for passing from any definite point (x, y) to another point (x′, y′) without any thought of coordinate change in the elementary sense. Thus the rule might be given in the form

$$x' = f(x, y), \quad y' = g(x, y).$$

Calling this transformation T, we can call the corresponding rule for passing from (x′, y′) to (x, y) its inverse T^{-1}. This has little meaning however unless the solution

$$x = \phi(x', y'), \quad y = \phi(x' y')$$

of the above equations leads to a unique (x, y) for any given (x′, y′). *Groups of transformations* are extremely important in Geometry and mathematical physics.

Three theorems about groups

Th. 1. *If a, b are any two elements of a group, then there is a unique element x such that $a.x = b$.*

Proof. The element $a^{-1}.b$ clearly satisfies the equation. There is no other solution since $a.x = b$ implies $a^{-1}.a.x. = a^{-1}.b$ and the left side of this equation is $e.x = x$.

Th. 2. *If a is any element of a group of finite order, then some power of a equals the unit.*

Proof. Nothing that, for example, $a.a.a = a^3$ (by definition) and that $(a^3)^{-1}$ is $a^{-1}, a^{-1}.a^{-1}$, it is clear that the ordinary law of integral indices holds in a group. Now $a, a^2, a^3, \ldots$ cannot all be different since the group is of finite order; hence for some integers r and, $a^r = a^s$, which implies that

$$a^r.a^{-s} = e \quad . \quad \text{Thus } a^{r-s} = e \quad .$$

It is easily seen that the set $a, a^2, a^3, \ldots a^h = e$ (where h is the smallest positive integer such that $a^h = e$) form a sub-group of (i.e. a *group* contained in) the original group. An interesting theorem about sub-groups is the following:—

Th. 3. *If a group of finite order n contains a sub-group of order h, h is an exact divisor of n.* We shall omit the proof.

PHYSICS

RECENT TRENDS IN THE STUDY OF THE ATOM NUCLEUS

(Abstract)

REV. JOHN S. O'CONOR, S. J.

This paper reviews the characteristics of the nucleus as determined from the past year's experimental research and indicates some of the requirements which must be met by an adequate nuclear theory.

The problems briefly discussed are: Scattering of Protons by Protons and the confirmation of a short range nuclear attractive force, as deduced from the work of Hafstad, Heydenburg and Tuve. The existence of the so-called "heavy electron", actual in the case of high energy cosmic radiation, chimerical in the case of electrons from Radium E. The possibility of an additional neutral particle of mass similar to that of the heavy electron, termed the neutretto" by Arley and Heitler.

THE SCOPE OF MODERN PHYSICS

(Abstract)

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

The paper comparies the view of Maritain on the scope of modern physics, with that of those scientists who are influenced by Kantian philosophy. For different reasons both come to the conclusion that modern physics is not primarily concerned with reality but is a science of mathematical symbolism.

The paper rejects Maritain's reasons by distinguishing between the pure possible and the physically possible. With different foundations in reality for the entia rationis in the two subjects, they should be considered formally different sciences.

ARE WE TRAINED FOR RESEARCH

(Abstract)

JOHN P. DELANEY, S. J.

Various pleas have been advanced condoning the sterility of Jesuit college professors in the field of research. Heavy teaching schedules, extra-curricular assignments, etc., undoubtedly frustrate in many cases every effort toward productive scholarship.

More frequently of late another plea has been entered, the lack of formal training for research. Whether true or false this alibi appears the least defensible of all. Great numbers of the world's greatest research scholars, past and present, have lacked the luxury of formal research training, which after all is but a very recent innovation. Such formal training undoubtedly is an asset but not a prerequisite for productive scholarship.

Presumably a college professor is well equipped in the fundamentals of his subject. He follows the literature, attends conventions and hears reports on research, understands the many and various unsolved problems and the possible methods for their solution. What further is required for productive scholarship than that he follow up his profession to the extent of delving into one or other of these problems and contribute his share toward their solution? His daily profession itself is his inescapable training for research.

DYNAMICS OF THE ROCKING CHAIR

(Abstract)

REV. THOMAS J. SMITH, S. J.

The paper presented an outline of the method of analysis, by means of the Lagrangian Equation, of the dynamical system of the rocking chair. The equation of motion for free ascillation was deduced with the help of experimental data and the damping ratio and related constants determined. Assuming a harmonic earth motion, the equation of motion for the resulting forced oscillation of the chair was then set up. The construction of a curve showing the relation between the period of earth motion and the actual magnification of the chair considered as a seismometer concluded the discussion.

THE VAPOR PRESSURE OF BISMUTH AND DETERMINATION OF FILM THICKNESS

(Abstract)

SIMON S. KIRSCH, S. J.

Work recently done at St. Joseph's College by Dr. Weber on the study of photoelectric properties of evaporated bismuth films shows that the photoelectric emission and threshold wave-length increase with film thickness to a limiting value. The time of evaporation of the films on glass was taken as a measure of the various film thickness. Knowing the vapor pressure of Bi for the evaporation temperature will simplify the work.

Consider an enclosure of absolute T containing ideal gas particles of mass m at a pressure p. From kinetic theory it is known that the number of particles escaping in unit time through a small opening ds into a solid angle element do in a direction making an angle e with the normal to ds, is given by

$$\frac{dn}{dt} = \frac{p}{\sqrt{2\pi mkT}} \, ds \, \frac{do}{\pi} \cos e$$

where k is Boltzmann's constant. Introducing instead the gas constant pro mole R, the molecular weight M, and the number of moles N, one obtains

$$p = \frac{dN}{dt} \frac{\sqrt{2\pi MRT} \; \pi}{ds \; do \; \cos e}$$

The latter equation can be solved for N, and therefore the weight of the deposit, obtaining finally the thickness of the film on the given area.

Since the vapor pressure of Bi is not known for the temperature used in the experiments, it is determined by solving the same equation where $\frac{dN}{dt}$ is made known by direct weighing.

Apparatus designed to fulfill the conditions of the equation consists of a pyrex tube connected to a mercury diffusion pump, and containing an evaporating unit, a thermocouple, and a slider for holding small microscope cover glasses on which the bismuth condenses. The heating unit is a section of molybdenum rod with a hole drilled in the bottom for a tungsten heating spiral. Bismuth is contained in a cylindrical pit in the top portion of the rod.

MAGNETRON METHOD FOR THE DETERMINATION OF e/m

(Abstract)

JAMES W. RING, S. J.

This paper describes the design and construction of apparatus suitable for the determination of the charge-mass ratio of the electron. The magnetron method outlined by Albert W. Hull (Phys. Rev. V. 18, p. 31, 1921) was followed. This method uses a diode with a fine filament along the axis of a cylindrical plate situated in a uniform magnetic field which is parallel to the axis of the plate. The magnetic field is supplied by means of a long solenoid. The paths of the electrons under the combined influence of the magnetic field and the radial electric field can be calculated and a relationship set up for e/m. The experiment itself is simplified, once the dimensions of the solenoid, cathode and anode are known, because only three sets of readings are required. The apparatus designed by the author gave results within seven per cent.

SEISMOLOGY

THE ELECTRO-MECHANICAL TRANSDUCER IN THE NEW BENIOFF SEISMOMETER

(Abstract)

JAMES J. DEVLIN, S. J.

This Paper dealt with a brief consideration of the electromechanical transducer described by Hugo Benioff in his article "A New Vertical Seismograph", published in the Bulletin of the Seismological Society of America for June 1932. It gave a more lengthy consideration to the revised model, with an analysis of the magnetic and electrical properties.

RECENT EARTHQUAKES IN THE NEW ENGLAND MARITIME PROVINCE

(Abstract)

WILLIAM F. BURNS, S. J.

At the May meeting of the Eastern Seismological Association, the Directors of the Stations in the New England Maritime Province, i.e., the New England States, New Brunswick, Nova Scotia, Canada as far west as the St. Lawrence, formed the Northeastern seismological Association. The Purpose of the Association is to gather and correlate data on all earthquakes and seismic disturbances in this region. The central station is located at Weston. The Dominion Observatory at Ottawa, the seismic stations of the University of Vermont at Burlington, Williamstown, Fordham, Harvard, a private station at Portland, Maine, and the M. I. T. Station at Machias, Maine send their reports to Weston by postcard and Weston compiles these reports and sends out a bulletin. To date one bulletin has been published and the second issue is immediately forthcoming.

Six quakes of interest have been recorded since the inauguration of this new association.

(1) June 9, 1938 with epicenter at

44°.5	North Latitude
63°	West Longitude

East of Nova Scotia about the same latitude as Halifax.

(2) June 15, 1938 with epicenter at

45°	North Latitude
66°	West Longitude

West of Nova Scotia in the Bay of Fundy

(3) June 19, 1938 with epicenter at

47°.5	North Latitude
60°	West Longitude

Northeast of Cape Breton Island

(4) June 23, 1938 with epicenter at

43°	North Latitude
71°.5	West Longitude

West Chelmsford, Mass.

(5) July 3, 1938 with epicenter at

45°	North Latitude
62°	West Longitude

Northeastern tip of Nova Scotia

(6) July 15, 1938 with epicenter at

48°	North Latitude
67°.5	West Longitude

In determining these epicentral distances the travel time tables of professor Leet of Harvard were used. These tables are based on the actual blast data obtained from quarry blasts throughout the New England region.

In addition two slight shocks, one on July 29, 1938 and another on August 2, 1938 were reported in the region of New York City. Neither of these quakes are as strong as the quake of July 16, 1937, which occurred in the same region. Work is being done at present on these quakes, and the results will be forthcoming in the near future.

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Members

Berry, Rev. Edward B., 1922, Fordham University.
Brock, Rev. Henry M., 1922, Weston College.
Burns, William F., 1935, Weston College.
Cohalan, Joseph F., 1934, Georgetown University.
Connolly, Rev. James K., 1933, Weston College.
Daley, Rev. Joseph J., 1920, Manresa Institute, South Norwalk, Conn.
Delaney, Rev. John P., 1923, Loyola College.
Depperman, Rev. Charles E., 1923, Manila Observatory.
Devlin, James J., 1934, Weston College.
Doherty, Rev. Joseph G., 1930, Cambridge University, England.
Dutram, Rev. Francis B., 1931, St. Robert's Hall.
Fitzgerald, John F., 1935, Weston College.
Frohnhoefer, Rev. Frederick R., 1926, St. Francis Xavier High School.
George, Severin E., 1933, Woodstock College.

Guicheteau, Rev. Armand J., 1932, Woodstock College.
Hearn, Rev. Joseph R., 1932, St. Ignatius, Inisfada.
Hennessey, James J., 1933, Woodstock College.
Heyden, Rev. Francis J., 1931, St. Andrew-on-Hudson.
Kelley, Rev. Joseph M., 1922, Loyola High School.
Kirsch, Simon C., 1937, St. Joseph's College.
Kolkmeyer, Rev. Emeran J., Canisius College.
Langguth, Laurence C., 1935, Weston College.
Linehan, Rev. Daniel, 1931, Weston College.
Love, Rev. Thomas J., 1923, Georgetown University.
Lynch, Rev. J. Joseph, 1925, Fordham University.
MacDonnell, Robert F., 1937, Boston College.
McAree, Rev. Joseph F., 1926, Brooklyn Preparatory.
McCarthy, John J., 1938, Boston College.
McDevitt, Edward L., 1933, Woodstock College.
McKone, Rev. Peter J., 1931, Rome, Italy.
McNally, Rev. Herbert P., 1922, Canisius High School.
Merrick, Rev. Joseph P., 1923, Baghdad, Iraq.
Miller, Rev. Walter J., 1931, St. Andrew-on-Hudson.
Morgan, Rev. Carroll H., 1933, Weston College.
Murray, Rev. Joseph L., 1928, Holy Cross College.
Nuttall, Rev. Edmund J., 1925, Manila Observatory.
O'Brien, Kevin J., 1933, Woodstock College.
O'Callahan, Rev. Joseph T., 1929, Holy Cross College.
O'Conor, Rev. John S, 1923, Woodstock College.
Phalen, Robert P., 1935, Weston College.
Phillips, Rev. Edward C., 1922, Woodstock College.
Quigley, Rev. Thomas H., 1925, St. Robert's Hall.
Reardon, Timothy P., 1935, Woodstock College.
Ring, James W., 1935, Weston College.
Schweder, William H., 1933, Woodstock College.
Sheehan, Rev. William D., 1928, Baghdad, Iraq.
Smith, Rev. John P., 1923, St. Peter's College.
Smith, Rev. Thomas J., 1925, Weston College.
Thoman, A. Robert, 1933, Woodstock College.
Tobin, Rev. John A., 1923, Boston College.
Welch, Rev. Leo W., 1932, St. Mary's Rectory, 45 Cooper St., Boston, Mass.
Zegers, Theodore A., 1934, Woodstock College.

THE PHILOSOPHY OF SCIENCE

Ahern, Rev. Michael J., Weston College.
Cotter, Rev. Anthony C., 1936, Weston College.

Coyne, Rev. Francis J., 1926, Boston College.
Dooley, Rev. Edward, 1936, Canisius College.
Eiardi, Anthony J., 1935, Weston College.
Glose, Rev. Joseph C., 1930, Woodstock College.
Kelly, Rev. Joseph P., 1931, Weston College.
Lynch, Rev. J. Joseph, 1925, Fordham University.
Murphy, Rev. John J., 1936, Boston College.
O'Beirne, Rev. Stephen S.J., 1935, Woodstock College.
O'Callahan, Rev. Joseph T., 1929, Holy Cross College.
O'Conor, Rev. John S., 1928, Woodstock College.
Ring, James W., 1935, Weston College.
Schoberg, Rev. Ferdinand W., 1936, Loyola College.
Sohon, Rev. Frederick W., 1924, Georgetown University.
Tobin, Rev. John A., 1923, Boston College.
Toohey, Rev. John J., 1934, Georgetown University.

N. B. IF THERE ARE ANY ERRORS OR OMISSIONS IN THIS LIST PLEASE NOTIFY THE EDITOR.