L. A. O'Donnell S.J.

S.J.B.

A. M. D. G.

American Association of Jesuit Scientists

Eastern States Division

PROCEEDINGS

of the

TWELFTH ANNUAL MEETING

August 21, 22, 23, 1933

Georgetown University, Washington, D. C.

Published at

LOYOLA COLLEGE

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PROCEEDINGS

FIRST GENERAL SESSION

The Twelfth Annual Meeting of the American Association of Jesuit Scientists, Eastern States Division, was held at Georgetown University, Washington, D. C., on August 21, 22 and 23, 1933. The first general meeting was held on August 21st at 7:45 P. M. in Gaston Hall, the Rev. Joseph J. Sullivan, S. J., presiding.

The Rev. W. Coleman Nevils, S. J., President of Georgetown University, delivered the address of welcome in which he reviewed the recent scientific improvements made at Georgetown, and in which he extended to all a very sincere welcome.

The minutes of the previous meeting were read and accepted as read. The chairman then named the following committees:

Committee on Resolutions:

Fr. Shaffrey
Fr. Ahern
Mr. Lynch

Committee on Nominations:

Fr. Love
Fr. Butler
Mr. Miller

Discussion on Father Quigley's suggestion that the Science Bulletin be limited to two issues per year was postponed to the final general session.

The time of the final general meeting was changed from 1:00 P. M. as per program, to 11:00 A. M. August 23rd, to permit of better train connections.

After the Secretary had read the financial report for the year 1932-1933, the President, Rev. Joseph J. Sullivan concluded the meeting with his Presidential address.

DISINTEGRATION OF ATOMS

While watching the clouds in his native hills of Scotland, C. T. R. Wilson noticed that as the warm air rose from the heath and expanded, clouds were formed, and as these clouds descended towards the earth and suffered compression from the layers of air above them, they were warmed and evaporated into thin air. He conceived the idea of making clouds in the laboratory, and the experiments he initiated

form one of the most conclusive arguments we have for the existence of atoms.

In a glass cylinder partly filled with water, he made his clouds, by first compressing the water vapor above the water, then permitting it suddenly to expand. As the air and water vapor expand, they cool and a cloud forms in the cylinder just as it did over the Scottish hills.

But when a cloud forms, each little drop of moisture in the cloud must condense on something. Usually, it condenses on a speck of dust floating in the air. After the dust has been removed, what then? There are always in the air broken bits of atoms or fragments of molecules, which we call ions. These ions are produced by the demolishing power of rays from radio-active substances found almost everywhere. So Mr. Wilson introduced a speck of radium into his glass cylinder to see what sort of clouds he would get. His clouds were formed in tiny white lines, beginning near the radium and diminishing at the end of a few centimetres. These little white lines are tiny clouds of water drops, condensed on the fragments of air molecules which were left in the track of particles shot out from the radium. Particles of some sort are therefore emanating from the radium. Let us see what they are.

If we begin by calling them alpha particles we shall have committed ourselves to nothing but a name. But what are their properties? Evidently they originate in the radium. They travel fairly straight paths, ionizing the air, each leaving a thin sharp line of cloudlet where it has torn through the air. Lord Rutherford captured a tube-full of these alpha particles to study their behavior, and on passing an electric discharge through the tube and examining the light emitted, he saw the brilliant spectrum characteristic of helium. So alpha particles are helium, first found in the spectrum of the sun and later isolated from the gases in the atmosphere. And the experiments of Wilson and Rutherford show us helium atoms being formed from radium—each fog track marking the birth of another helium atom.

We could count these atoms as they leap forth from a radium compound. This might be done in an expansion chamber counting the fog tracks as Wilson did. We might allow the alpha particles to strike against a Barium Sulfide screen and count the tiny sparks given forth at each encounter. A better method is to allow these particles to enter an electrical counting chamber. For these alpha particles carry a positive electro-static charge, and each particle can be made to leave a record of its entrance on a moving film. Every little peak on the film will mark the birth of a helium atom from its parent radium.

Imagine that we have counted these helium atoms, enough to fill a tiny tube, whose volume is the volume of a pea. How many atoms would we have? At atmospheric pressure, the number of helium atoms would be about one with nineteen ciphers after it. To get an idea of

the number this implies, we find that if this number of atoms were distributed equally to all the inhabitants of the world, each one would receive about 100,000,000 of them.

And so we have pictured these tiny motes called atoms, in this instance helium atoms being formed from the parent substance, radium. We have counted them and identified them and acquired some idea as to their size. And in doing this, we have examined one of the most cogent bits of evidence the scientist has to offer in proof of the existence of atoms.

Let us now see how far we can disintegrate the atom. Can the atom be picked apart and its elements isolated? To a certain extent this has been done in a most ingenious way. Using an expansion chamber, as Wilson did, let us send a beam of x-rays along its length and observe the results. A photograph will show that most of the beam goes through with no deviation. But here and there are very fine fog tracks, much finer than in the case of the moderately heavy alpha particles. These fog tracks are the paths of other particles, which we shall call beta particles, and in their wake they have left the tiny cloudlets. These beta particles have been knocked out of the air molecules by the energizing action of the x-rays. Further examination would show the same beta particles knocked out of oxygen atoms, out of nitrogen or carbon atoms by these same x-radiations. In fact, if we had a pair of spectacles or a piece of sirloin steak in the path of these x-rays, the same beta particles would be observed. Now we know that oxygen atoms differ from nitrogen atoms and both are different from sulfur atoms and all three different from carbon atoms. And beta particles go into the make-up of all of them. They are therefore even more fundamental than atoms.

But what are some of the properties of these beta particles? In the first place it is found that they carry a negative electrostatic charge. If a magnet is held near the expansion chamber, their paths curl up. This because a moving charge acts like an electric wire with the current flowing. It generates a magnetic field and is therefore affected by a magnet.

Professor Milikan spent years at the University of Chicago measuring the charge carried by one of these beta particles. His experiments with oil droplets are considered classic in the history of experimental science. He actually succeeded in calculating the unit change—the charge on a beta particle trapped in an oil droplet.

And because these beta particles carry the unit electric charge, they are called electrons. Incidentally, we might also say that they are the scientist's evidence that electricity is atomistic—that is, that it acts as though it were composed of tiny particles, even as matter is subdivided into atoms.

These beta particles or electrons have also been weighed. The smallest atom known is the atom of hydrogen, one fourth as heavy as helium. But an electron weighs only 1/18000 as much as a hydrogen atom. It is no wonder then that the fog track made by the beta particle should be very much smaller than the easily visible line witnessed by Wilson in his study of the alpha particle.

We have then isolated one of the components of the atom—the electron—called at times a beta particle—a tiny mote carrying an electric charge of unity—whose mass is 171845 that of the hydrogen atom. From other work, initiated by a young Englishman named Mosely, and carried on in later years, we can count the number of electrons that each atom has. Hydrogen has one electron; Helium, two; Lithium three and so on. Nitrogen has seven electrons per atom, iron, 26, and uranium the heavies atom of them all, 92.

But what about the rest of the atom? The atom, as we know, is electrically neutral and the electrons which are constituent parts of the atom carry a negative charge. Do we know anything about this positive part, the residue which is not decomposed by x-rays?

Something has been found out, and I shall try to describe it. First this positive part of the atom, which acts like a core has been ascertained to be very small. In it is concentrated most of the mass of the atom: so that although it is much smaller than the atom, it has most of the atom's weight. Rutherford and Aston in England and Dempster at the University of Chicago have achieved distinction in this work—one of the cleverest pieces of experimentation in the past fifteen years.

They have shown that the weights of these positive nuclei in different atoms are whole number multiples of a unit which is nearly equal to the weight of the hydrogen nucleus. This suggested the possibility that hydrogen nuclei may be the building stones from which the nuclei of larger atoms have been assembled.

If this were so, and enough crushing power could be exerted on these atomic nuclei, they should crumble into hydrogen nuclei. At least, some of the building stones should be pried away and this has, in truth been done and by Lord Rutherford, who has figured so prominently in previous experiments.

It was known that alpha particles when shot forth from radium are hurled at an explosive speed. So Rutherford bombarded nitrogen gas with alpha particles and the result was startling. Most of the alpha particles pass through the gas, indicating how small these atomic targets must be. But when an alpha particle hits a nitrogen atom head on, a hydrogen nuclei is knocked out of the nitrogen atom. And the nitrogen residue plus the alpha particle becomes an atom of oxygen. The Alpha particle has acted like a hammer. It has broken the atom of nitrogen and the fragment broken off is a hydrogen nucleus.

Similar experiments have been done with many other elements, and the part expelled by this bombardment is always a hydrogen nucleus. It would seem then that this hydrogen nucleus, whose weight is almost equal to that of the hydrogen atom, and which carries a positive electrostatic charge equal in value but opposite in sign to the electron is one of the fundamental constituents of the atom. And so it has been named a proton, that is the primary or basic thing. Out of protons, therefore, and electrons the scientist believe that all of the 92 elements have been constructed.

It is one thing, however, to know of what a thing is made and another to know how the constituents are put together. How are these protons and electrons assembled for instance in the atom of helium? Once more the scientist reaches for his x-ray tube, the latest and most valuable microscope he possesses for prying into the secret hinterland of atomic structure.

By comparing data obtained by sending a beam of x-rays through atoms of air or relium, it is possible to get an idea not only of the size of the atom but also of its shape. From these data the atom would appear as a tiny fuzzy ball.

In the middle of this fuzzy ball is the nucleus in which are the protons. It is positively charged and in the case of the helium nucleus, it has two unit positive charges. The fuzzy atmosphere around the nucleus is due to the electrons. There would be two of them for the helium atom. If we wonder how two electrons could be diffused throughout this electronic atmosphere, we have only to recall that a fast moving lantern can describe a circle and leave a phantasm of a circle in our mind. It is only one lantern, yet when swung rapidly in a circle, it appears to be manifold. In the same way, the electrons give a diffuse continuous spherical appearance to the atom because they are now here and now there. And our picture would be a blurred "time exposure" of their average positions.

As a result of all the experiments to date, there are many theories proposed, as we know, regarding the structure of the atom. Kelvin thought it looked something like a smoke ring. J. J. Thomson presented the picture of a sphere of jelly. Rutherford suggested a miniature solar system, with the electrons revolving around the nucleus, while Bohr and Sommerfield calculated the orbits of the planetary electrons moving about this central nucleus. Here in America, Lewis and Langmuir want an atom shaped like a cube. Lande prefers a tetrahedron. The latest theories go back to the spherical picture. Schrodinger says: "It is a diffuse atmosphere to electricity around a central core." And Heisenberg modifies this by saying: "It is a diffuse atmosphere of electricity due to electrons moving now here now there."

Each of these theories has, of course, some foundation in physical or chemical or spectroscopic data. Each succeeding one has undoubtedly

improved on its predecessor. But the picture which seems to agree best with information so far obtained is that of Heisenberg: a fuzzy ball—made up of a central nucleus with an atmosphere of electrons whose haphazard positions would seem to make this atmosphere continuous.

On analysis, then, the helium atom would consist of a nucleus surrounded by two electrons. The nucleus is found to consist of four protons, two of which are paired with electrons, so that the resultant electrostatic charge on it is two positive units. This positively charged nucleus we have said is identical with the alpha particle.

How now are the protons and electrons arranged in the nucleus? That is the problem we have not succeeded in solving. Whatever arrangement there is we know must involve tremendous energy changes. We saw that the alpha particle was shot forth from the radium nucleus. But have we any idea of the energy transferred in that disintegration? It is about a million times as much as when a molecule of T. N. T. explodes. It is enough to crack apart a nitrogen atom and liberate a hydrogen nucleus. But because these alpha particles break forth from the radium one at a time, their effects are only observable to those who make special effort to find them.

One of the great enigmas of science has been the source of all the energy which comes from the sun in the form of heat. If the sun were pure coal burning in oxygen, it would shine with its present brilliance for only a few thousand years—less than the era of history—before it would be reduced to a cinder. If we can, however, evaluate the stores of energy within the nucleus of the atom, we will have a very plausible answer to the origin of the energy of the sun. Professor McMillan has offered the suggestion that the sun is consuming itself. If under the extreme pressure and temperature of the sun's interior, the electrons and protons of a single atom could come together and neutralize each other, all of their energy would be liberated and add to the sun's heat. The energy released would be almost beyond belief. If all the energy could be thus unleashed from five drops of water, it would run all the power stations in Washington and its surroundings for twenty-four hours.

It is the nucleus of the atom therefore which is a storehouse of unmeasured quantities of energy. And it is the nucleus of the atom which still presents to us a fascinating mystery.

Electrons and protons, therefore—these are the parts of the jig-saw puzzle which is the atom. We know that the electrons form a hazy atmosphere around the nucleus. The appearance and properties of this electronic atmosphere are rather familiar. But the heart of the atom, the nucleus, still holds many secrets. And it is in the future study of this nucleus that the stethoscope of experiment will reveal stores of hidden treasure.

FINAL GENERAL SESSION

On Wednesday, August 23rd, at 11:00 A. M. the final general session was held in Gaston Hall.

The Secretary of the Association reported the admittance by the Executive Council of the new members.

Fr. Francis P. Le Buffe and Fr. Joseph C. Glose were received into the Association as honorary members.

The Secretary announced the reappointment of Fr. Richard B. Schmitt as Editor of the Bulletin, and the appointmtnt of the following as Associate Editors:

Rev. Henry M. Brock
Rev. Francis G. Power
Rev. Clarence E. Shaffrey
Rev. Frederick W. Sohon

Father Schmitt then outlined the duties of the new Associate Editors.

The Secretaries of the sections then reported the officers for the coming year:

Biology:

Chairman, Fr. Charles A. Berger
Secretary, Mr. Arthur A. Coniff

Chemistry:

Chairman, Fr. Francis G. Power
Secretary, Mr. Alvin A. Hufnagel

Mathematics:

Chairman, Fr. Frederick W. Sohon
Secretary, Mr. Walter J. Miller

Physics:

Chairman, Fr. Emeran J. Kolkmeyer
Secretary, Mr. Edward L. McDevitt

Next followed the report of the Committee on Resolutions. Fr. Shaffrey read the following resolutions which were unanimously accepted as read:

RESOLUTIONS

At the twelfth annual meeting of the Association of Jesuit Scientists, Eastern States Division, held at Georgetown University, Washington, D. C., the following resolutions were unanimously passed:

1. The American Association of Jesuit Scientists, Eastern States Division, expresses its heartfelt gratitude to the Very Reverend Fathers Provincial of the Maryland-New York and the New Eng-

land Provinces for their constant interest and inspiration in the work of the Association. We pledge to them our best endeavors in carrying out the teaching and research work in science of both provinces.

2. We express also our grateful appreciation to Father Rector, to Father Minister and to all the members of the faculty of Georgetown University for the splendid hospitality which they have offered to us, and for the complete arrangements for our comfort during the convention. We congratulate the University on the remarkable progress in buildings and in scientific equipment since our last convention at Georgetown. This progress is an inspiration to all of us.

3. The American Association of Jesuit Scientists, Eastern States Division, hereby records its resolution to support whole-heartedly the President of the United States in his efforts towards National Recovery.

4. We note with delighted approval the work of our colleagues holding the chairs of philosophy in the various colleges of the two provinces in seeking to bring about a completely harmonious relation between science and philosophy. Specifically we approve of, and promise our generous aid to the compilation of a glossary of philosophical-scientific terms as an important aid to the consummation of this harmonious relationship.

5. We urge upon our members active participation in the meetings and the work of the various scientific societies dealing with our respective branches of science.

Respectfully submitted:

M. J. Ahern, S. J.

C. E. Shaffrey, S. J.

A committee of four was then appointed to act in conjunction with a similar committee from the Jesuit Philosophical Association in order:

1) That the difficulties in our Philosophy arising from scientific findings be discussed and solutions suggested.

2) That a Scientific-Philosophic dictionary of terms common to both subjects be compiled.

The members appointed to this committee were Fr. Francis G. Power, Fr. John A. Frisch.

Fr. Joseph P. Kelley then thanked the Association for the appointment of the above committee.

It was decided not to decrease the issues of the Bulletin, but to increase them, if possible.

The report of the Committee on Nominations was called for. Fr. Love announced that the Committee had decided to place in nomination Fr. Power and Fr. Quigley for the office of President and Mr. Molloy and Mr. Flood for Secretary. Fr. Power requested to be permitted to withdraw his name because of his many other duties. This request was granted, and then Fr. Ahern moved that Fr. Quigley be unanimously elected. This motion, seconded by Fr. Power, was unanimously carried. Mr. Molloy was then elected Secretary.

A motion entered by Fr. Love that the Secretary of the Association keep a permanent "Minutes Book" independent of the printed report in the Bulletin was carried.

Fr. Brock's amendment to the above motion, namely that the secretaries of the individual sections likewise keep a permanent "Minutes Book" of their own section was likewise carried.

Fr. Berger then moved that a press agent for future general meetings be appointed one month in advance. This motion was seconded and carried.

The meeting was then adjourned.

At a meeting of the Executive Committee, the following were admitted to the Association:

Mr. John F. Carroll, Woodstock College.
Mr. James H. Connolly, Boston College.
Mr. Bernard A. Fiekers, Boston College.
Mr. Francis C. Garvin, Woodstock College.
Mr. Severin E. George, Fordham University.
Mr. James J. Hennessey, Woodstock College.
Mr. Edward J. Hogan, Holy Cross College.
Mr. Alvin A. Hufnagle, Georgetown University.
Mr. Gerald F. Hutchinson, Holy Cross College.
Mr. Matthew M. Kane, Woodstock College.
Mr. Edward L. McDevitt, St. Peter's College.
Mr. Carol H. Morgan, Holy Cross College.
Mr. John J. O'Brien, Woodstock College.
Mr. Kevin J. O'Brien, Woodstock College.
Mr. Philip H. O'Neil, Ateneo de Manila.
Mr. Anthony J. Quevedo, Woodstock College.
Mr. Albert T. Rooney, Fordham University.

Mr. William H. Schweder, Woodstock College.
Mr. Joseph F. Stoffel, Woodstock College.
Mr. Robert A. Thoman, Woodstock College.
Mr. John J. Walsh, Georgetown University.

The following members of the Association were present:

Rev. M. J. Ahearn
Rev. T. D. Barry
Rev. C. A. Berger
Rev. H. J. Bihler
Rev. H. M. Brock
Rev. J. S. Busam
Rev. T. P. Butler
Rev. H. L. Freatman
Rev. L. C. Gorman
Rev. J. L. Harley
Rev. J. R. Hearn
Rev. A. J. Hohman
Rev. J. M. Kelley
Rev. J. J. Kelly
Rev. E. J. Kolkmeyer
Rev. T. J. Love
Mr. E. A. Anable
Mr. A. A. Coniff
Mr. T. A. Duross
Mr. F. X. Flood
Mr. E. S. Hauber
Mr. J. G. Keegan
Mr. J. P. Lynch
Rev. J. J. Lynch
Rev. H. P. McNally
Rev. P. A. McNally
Rev. J. P. Merrick
Rev. T. H. Moore
Rev. E. J. Nuttall
Rev. J. S. O'Conor
Rev. F. G. Power
Rev. T. H. Quigley
Rev. R. B. Schmitt
Rev. C. E. Shaffrey
Rev. J. P. Smith
Rev. T. J. Smith
Rev. F. W. Sohon
Rev. G. F. Strohaver
Rev. J. J. Sullivan
Rev. J. A. Tobin
Mr. G. P. McGowan
Mr. P. H. McGrath
Mr. W. J. Miller
Mr. J. J. Molloy
Mr. H. A. Pfeiffer
Mr. L. J. Walsh
Mr. J. J. Walsh
Mr. W. G. Walter
Mr. L. G. Welch

BIOLOGY

RECENT ADVANCES IN CYTOLOGY

(Abstract)

Rev. Charles A. Berger, S.J.

A brief summary of some of the more important ideas regarding chromosomes that had been brought forward during the past ten years as a result of the revival of interest in chromosome cytology. The discontinuous spireme. The spiral structure of metaphase chromosomes and the explanation of the change of chromosome shape from prophase to metaphase by the assumption of the spiral form. The time of chromosome division appears to be during the resting stage preceding mitotic division and during the prophase of meiosis. The chief observable differences between mitosis and meiosis may thus be explained by a delayed division into chromatids at the onset of the maturation divisions. Darlington's theories that chromosomes are attracted in pairs, that metaphase pairing results from chiasmata, and that chiasmata are the result and not the cause of crossing-over, were reviewed.

N. B.—The Scholastic Vitalism . . . by Fr. Joseph Glose, S.J., will appear in full in an early issue of the Bulletin.

DRIESCH'S EUTELECHY

(Abstract)

John P. Lynch, S.J.

1. What Entelechy is . . . "That factor in life phenomena which is the factor of the true autonomy characteristics of all living organisms."

2. History of the development of Driesch's theory . . . Driesch was a mechanist, an ardent disciple of Haeckle. Experiments in the embryological morphogenesis of Echinoderms turned Driesch toward Vitalism.

3. How Entelechy operates . . . Teleologically:

a) By suspending and then setting free, regulatively, reactions based upon potential differences.

b) Suspends by Immaterial Resistance, i. e. by "prohibiting", as it were, certain paths of motion to the elements of a material system, according to a particular design, so to speak.

4. Principal notes of Entelechy . . .

1. Not Energy
2. Not Force
3. Not Intensity
4. Not Spatial
5. Not a Constant in the sense of physics
6. Lacks all characteristics of Quantity
7. A true element of Nature, i. e., a natural agent per se
8. Root of Regeneration and Adventitious Budding
9. Root of Inheritance (at least of its Outcome)
10. Exclusive cause of all Order in Morphogenesis
11. Natural elemental agent *forming* the body; natural elemental agent directing the body, i. e. the root of all *action* in organisms.
12. Prospective Potency
13. Intensive Manifoldness resulting in Extensive Manifoldness
14. Has Inherent Diversities
15. Is affected only by the accomplishment of its own performance
16. Entelechy is called into activity by changes of any normality governed by it which are due to external causes, and these changes do not affect Entelechy as a mere sum of changed singularities, but as changes of normality as a whole, while the activity of Entelechy relates immediately to *single* inorganic events, though *in the service of normality.*
17. Entelechy does not depend for its existence on anything material but only for its activity.
18. Entelechy is the same entity which is usually called *soul* or *mind,* being the unconscious ultimate foundation of the conscious Ego with all his experiences
19. Entelechy is a living person's essence: at a given moment it exists in a double form,—in part actually manifested; in part having potency for being manifested
20. Entelechy is a quasi-substance, in the sense of an intensive manifoldness of the form of wholeness and totality. But it may appear under the form of a potential and of an actual state
21. Entelechy is quasi-causality. "Actu" it causality of the individualizing form. Some sides of it in each case are manifesting themselves in this form.

Driesch has gone through great labor in trying to elaborate his form of Neo-Vitalism. His justifying principle for his theory of Entelechy he states as follows: "Something new and elemental must always be introduced whenever what is known of other elemental facts is proved to be unable to

explain the facts in a new field of investigation''. Driesch rejects Chemistry and Physics as causality for organic individual development, denounces any and all forms of Mechanism as explanatory of Morphogenesis and Activity in organisms. Driesch admits his own theory of Entelechy is inadequate and rather confusing,—rather difficult to comprehend. He says ''The characteristics of Entelechy form only a complicated system of *negations* so far, and little more,—and so it must be till we are prepared to change our whole view of reality, and of natural reality in particular, as in fact we very soon shall''.

Driesch knows nothing about the origin and end of individual life and the origin of life in general,—and is frank about it,—also: ''Nothing can be said concerning the absolutely primordial relations between Entelechy and elemental materiality''.

THE TELEOLOGICAL MECHANISM OF L. J. HENDERSON

(Abstract)

ARTHUR CONIFF, S.J.

The first proposition Mr. Henderson sets out to prove may be stated as follows: ''The material world with its physical and chemical properties is unique, and the fittest possible environment for the support of life.'' He proves this proposition by an exhaustive and scientifically exact study of the many singular physical and chemical properties of water and carbonic acid and the unique combining qualities of carbon, hydrogen and oxygen. All the properties investigated result in a maximal and unique fitness for maintaining life, which is a physico-chemical process, and as such possesses complexity, regulation and metabolism. To proceed to Mr. Henderson's philosophical deductions his problem is this: Environmental fitness for life is so striking that it cannot have been due to chance. Antecedent to adaptations, it is a natural result of the properties of matter and energy, and as such it cannot be dismissed as gross contingency. By what law then can we account for it? Perceiving a reciprocal relation between the fitness of environment and the fitness of organisms (or adaptations), he offers his solution. These two processes, namely cosmic evolution and organic evolution, are not two distinct things, but they rather constitute a single orderly development that yields results, not merely contingent, but resembling those which in human action we recognize as purposeful. For two things which are related together in a complex manner by reciprocal fitness make up in a very real sense a unit. This single orderly development that yields purposeful results is Universal Teleological Mechanism.

Mr. Henderson escapes the final causality of scholastic philosophy by a simple extension of his argument as follows: Cosmic evolution is pure mechanism, yet issues in fitness, why not organic evolution as well? Mechanism is enough in physical science which no less than biological science appears to manifest teleology; it must therefore suffice in biology. Thus, he continues, we arrive at a negation of Vitalism for two reasons. *First*: Organic and inorganic phenomena are alike, i. e., pure mechanism, therefore a specifically vital teleology is unnecessary; *Second*: Inorganic science unquestionably has no need of non-mechanistic teleology, hence we are obliged to conclude that all metaphysical teleology is to be banished from the whole domain of natural science. In this hypothesis Vitalism has ceased to be exclusively organic, to be vitalism at all, and has become mere universal Teleology.

Teleology according to Mr. Henderson is a tendency that can not have originated in or through mechanism, but is a necessary and pre-established associate of mechanism. It is not matter; it is not energy; it is just a directive tendency. For the scholastic to say that a thing shows order, purpose, or design in its nature, is merely another way of saying that it has a final cause, or an end. This end is called the "finis operis" and is that towards which the created world tends by its own activity. Furthermore the "finis operis" exerts true causality, though not as its physically exists, but it is a cause before it physically exists, that is as it exists in the intention of the efficient cause. Intention, considered as the act by which an end is sought, may therefore be either in the will of an intelligent efficient cause, or in nature. Intentional activity of nature is a blind determination by which created things from an inclination of nature are impelled to follow the natural order. And here we note that no intentional activity of nature or blind determination is possible which does not depend on some intention of a will and a directive intelligence. Thus in the matter of the created world I judge it to be an effect of such marvelous order, design and purpose that I am unable to assign a sufficient reason for its existence, unless I admit that it was intended to be such. In other words that it has a final cause. To return, therefore, to Mr. Henderson's argument in which he claims to have abolished Vitalism: If the establishment of fixed laws did away with former ideas of order and purposive activity in the inorganic world, then it might logically follow that fixed laws for organic activity might do away with every idea of purpose and design in living things, and, its foundation thus destroyed Vitalism be untenable. But the antecedent here is entirely false. The establishment of chemical and physical laws merely formulates what may once have been conceived under the general idea of order and purpose, and, if anything, their discovery gives greater validity to a true concept of final causality. Hence it does not follow that the finding of fixed laws for organic activity destroys its claim for purpose and design. Vitalism may rest content as far as Universal Teleology is concerned. (cf. "The Fitness of the Environment"—by L. J. Henderson).

THE NEO-MECHANISM OF NEEDHAM

(Abstract)

HAROLD A. PFEIFFER, S.J.

Professor Needham's proofs for his doctrine are two:—*First*, that there is not as much teleology about the living organism as its proponents believe. *Second*, If there is any teleology it is the universal teleology of Henderson.

As regards his first argument, Professor Needham advances proof from what he calls chemo-differentiation in gastrulation of the chick embryo, the development of terata and the obvious dependence of the embryo in selecting its nutrient material. He first attacks the Driesch experiment. "Why does not this phenomenon of teleology, so evident in the blastula, continue?" he asks. Even as early as gastrulation this phenomenon has ceased. A second process known as cell differentiation has taken place. This the mechanists prefer to call chemo-differentiation and with this change they claim that the thread of teleology vanishes. But what justification is there for this supposed chemo-differentiation? There is no external interference. Any justification for this differentiation must be internal. But since, according to the Mechanists, the embryo follows mechanical and chemical laws why should one law cease and another begin? Why should similar cells, having similar chemical properties and under similar conditions, suddenly give up some of these properties and acquire others? It is an axiom in chemistry that the resulting compounds of a chemical reaction will always be the same where the conditions are the same. Only by a change of temperature, or excess of one element or compound will there be a change in the resulting reaction. Mechanical laws also follow an inexorable path. Certainly both milk separators and milking machines follow definite mechanical laws. If we were to accept the Mechanists' doctrine of embroylogical development, we might easily expect the cream separator suddenly to become a milking machine and vice versa. As for the chemical world, it would be chaos, if without a change of conditions, specific for each definite reaction, one could expect practically any result.

However should we add an intrinsic purposive and directive principle, which we prefer to call the vital principle, tending toward a complete individual, directing each change in this developmental progression, there is very, very, much reason and little rhyme to the difficulty. And far from attenuating the thread of teleology it has woven the thread into a strong and sturdy cable.

But if this directive principle governs those beautifully adjusted processes in embryological development, what shall we say of teratology? By demonstration the Mechanists have proven that a chick embryo at a certain stage in its development, if heated locally, will go on developing, but all awry. A whiff of hydro-cyanic acid blown into the incubator, an electric field or a slight asphyxia will all cause abnormal development resulting in terata.

From the above description of the methods used in developing the terata, the striking note is outside interference. There is grave doubt whether these opponents of teleology fully understand just how the purposive principle really functions. It seems as if they would require some external manifestations of the principle during their interference and in a certain sense they receive it in the form of terata. Now the intrinsic principle of life functions only under certain conditions which are logically called the normal conditions necessary to reach its end—the complete individual. It is no gymnast, contorting itself in various ways to meet various conditions. Therefore due to the obstacles placed in its path of manifestation by this interference—that is, under abnormal conditions—it cannot function normally. If the interference influences the entire embryo, death results. If however, the interference is only local, the course of action to a certain extent is deviated, yet the principle continues to strive for its defined end. And so we find that unusually rapid cell proliferation, of a part of the embryo resulting from heightened temperature in that region, or retarded development due to one section's contact with an electric field will cause that part of the embryo to develop abnormally. But the parts that have not been affected, the parts which have been subjected to no interference, will show normal, progressive development.

In interfering with the normal development of the chick embryo, the opponents of teleology would insist that the directive principle, if it exists, should overcome the interference and proceed normally. On the contrary the power of the principle is emphasized by the fact that despite its local abnormal conditions, the parts which have suffered no retardation or acceleration have continued along normal lines to normal results.

Were it not that Professor Needham unwarrantedly asserts the Mechanistic principle for what is obviously Vitalistic, we might forego his third argument that teleology is not so manifest in living beings. It has been found experimentally by means of chemical analysis of developing chick embryos that there is a cycle in their growth according to which they first burn sugar as a source of energy, next protein and finally fat. By injecting considerable amounts of sugar into the yolk at the beginning of incubation it was further discovered that despite this excess of sugar, which was put at their disposal, the embryos began to burn protein at exactly the usual time.

The important point of this experimentation is that when the hour came for the embryo to burn protein, it did so, no matter what was outside in the nutrient material. Not the mere concentration of the foodstuffs in the yolk but some factor inside it determined what it should burn. Shall we call this factor the directive principle? Professor Needham asserts, "I prefer to put it down to some physico-chemical factor." But what are the proofs of this assertion? He gives none except his aversion "to writing a book on the failings of Mechanism."

But do machines act in this manner? Will a machine fueled in excess, motivated by a definite physico-chemical factor suddenly subject itself to a distinctly different physico-chemical factor? This will only be done when motivated by some outside directive force. Both gasoline and benzine will fuel an engine. The engine itself will react according to different physico-chemical laws when each of the respective fuels is used. But even the most rabid Mechanist would scarcely expect a machine, fully fueled with gasoline, suddenly to stop running and demand a change to benzine. As long as the gasoline lasts the engine will continue to function, entirely disregarding the use of benzine.

But with the embryo, there is something within it that is in control of the situation. Although there is extra sugar, that is, fuel, in the yolk, it is not cajoled into burning up the sugar. Unlike the engine, it refuses to use any longer the excess sugar. Its directive principle will not permit it to burn the sugar when it normally burns proteins. The embryo is master of the situation, directed in such a manner that it seeks a new and different, yet definite fuel, at a definite time.

In presenting these ontogenetic arguments the Mechanists have unwittingly emphasized the necessity of teleology in the living being. From the citation of their experiments they have set forth various physical and chemical laws manifested by the developing embryo. Satisfactorily they have obtained valuable facts for the particular sciences of bio-physics and bio-chemistry. But they have failed to answer the *Why* and *What* of these laws. Why in gastrulation do the octodermal cells show different chemical properties than the entodermal cells? Why, in the developing embryo, do those parts, not interfered with, continue to show normal organization? Why does the embryo so stubbornly refuse to burn up the excess sugar in the nutrient material? And above all, since there is no outside factor to determine them, what brings about these psysico-chemical changes? A Mechanist merely substitutes by other words the already harassing "What." The Teleologist's explanation satisfactorily gives the answer and lays the ever-present and irritating "What" to rest.

In Professor Needham's second argument, namely, that teleology is not unique or characteristic of the living being, he has done nothing more than advance Professor Henderson's doctrine of universal teleology. This is explained and answered in another part of the symposium.

And so we come to the conclusion of Professor Needham's arguments in defense of the Mechanistic doctrine. Shall we grant what he calls a Merchanstic Fiction, or shall we reserve our right to reality—to make one's observations and conclude to a higher principle, not sensible, but evident in its manifestations, a harmonious progression of directed actions ever working to bring about the good of the complete individual.

THE HOLISM OF J. C. SMUTS

(Abstract)

J. Franklin Ewing, S.J.

Neither a scientist nor a philosopher, General J. C. Smuts has produced a theory of evolution which is chiefly important as an example of the growing discontent with pure mechanism. Things and concepts are not definitely discrete, but are to be considered as a point of light with surrounding penumbra shading off into darkness. This "field" is important in his theory. From Relativity and modern physics, he deduces that all matter is energetic structure. Colloids closely approximate life-matter, and here the jump was probably made. The cell is the first obvious "whole", with a system of organic regulation and cooperation. The "whole" is more than the sum of its parts, but the summation of the forces of the parts in Space-Time, which yields something entirely different. The various levels of Holistic action are: material structure with chemical and physical energies; functional structure, as in plants; function structure and centralised control, as in animals; conscious central control, human Personality and Society; the State; the ideal wholes, Absolute Values, such as beauty, truth and goodness. The Holistic Principle is creative and regulative. Both Mechanism and Vitalism are wrong: Mechanism because it ignores the obvious facts of the Mind, Vitalism because it introduces an unnecessary element. In Evolution, modifications are produced by the continuous pressure of the environment on the whole, which are registered for a long time only in the field, which surrounds the material structure seen in the microscope. When the organism acts upon these variations in the field, a change takes place in structure. The "via media" between Merchanism and Vitalism is yet to be found, for Holism is reduced to Mechanism. The theory is the result of an overdose of monism and confusion of ideas.

THE HOLISM OF J. S. HALDANE

(Abstract)

Joseph G. Keegan, S.J.

I. Exposition of the doctrine.

1. Phenomena of life are the active manifestations of a persistent whole, in which

   A. the organism

   B. the environment

   are so coordinated in structure and function as to form one single 'sum-total' or life.

2. This life has organic and environmental structure and is not spatially limited.
3. The holistic concept illustrated
   A. By comparison with the mechanistic concept
   B. By comparison with the vitalistic concept.

II. Evidence for the doctrine.

1. Negative
   A. From demonstration of fallacies of mechanism, i. e. coordinated maintenance inconsistent with physical conception of self-existent matter and energy, as confirmed by,
      a) inapplicability of general relationship of action and reaction.
      b) facts of organic variation and hereditary transmission.
      c) individual differences
      d) identity of structure and function.
   B. From refutation of vitalism, i. e., the directive principle of the vitalist fails to take into account the unity of organic and environmental structure.

2. Positive
   A detailed application of the biological concept to the specific structural and functional factors of organism and environment in the complex phenomena of respiration.
   A. Regulation of blood gases by variation in inspiratory depth.
   B. Regulation of the blood reaction
      a) Renal activity
      b.) The buffering mechanism
   C. Regulation of oxygen tension within the body
   D. Acclimatization to high altitude.

III. Criticism.

Although he disavows any treatment of ultimate causes Professor Haldane finds no difficulty in outlining a pantheistic world-view. One wonders if the Professor's distinction between science and philosophy can be more than a verbal one. In the main however, the three lectures create a unified impression and J. S. Haldane is careful to maintain his viewpoint, even when reiteration must serve as his only weapon. The lectures serve a very useful purpose in portraying rather clearly the relationship between the formal objects of physical science, biological science and psychology. Haldane's account of respiration as a unified and coordinated process is excellent. This is undoubtedly the most constructive portion of his treatise but still the reader is not impressed at the conclusion that Haldane's final interpretation is the only one available. The author is quite assiduous in showing the inadequacies of the mechanistic doctrine but his disposal of vitalism is quite summary and jejune.

M. W. WHEELER ON EMERGENT EVOLUTION

(Abstract)

Rev. Harold L. Freatman, S.J.

Emergence is a novelty of behavior arising from the specific interaction or organization of a number of elements whether inorganic, organic or mental, which thereby constitute a whole as distinguished from their mere sum or resultant. This emergence does not connote something preexisting, something epigenetic, miraculous. The union of hydrogen and oxygen to form water is the classical example of emergence. They combine under certain conditions and in certain proportions to form a liquid emergent, water, exhibiting a very different behavior from that of either its gaseous components.

Such emergence may be either progressive or retrogressive. It is best seen in lower animals and especially in symbriotic creatures. All mystery disappears, if we realize an interstitial filling, real as the elements of the emergent whole. Their interstices along with environment may give rise to emergence, which according to Morgan, are beyond the wit of man to number. Emergence are not too schematic, too rigid, too static, since the new "whole" constituted by the intergrated and organized parts need not be regarded as novel in its entirety. Mr. Wheeler insists that emergence do not arise at once, but are more ambulatory, yet not saltatory. Novelity at each emergence must be very small, but novelty exists, as can be seen in every event, atom, molecule, organism, personality. Metamorphosis in organism is only superficially saltatory. In the union of colonies of bees, of wasps, of ants with colonies of alien species, this emergence is demonstrated by Mr. Wheeler.

Man, as well as insects, demonstrates emergence both progressively and retrogressively. Progressively in his continual predatism on his neighbor; retrogressively in the atrophy of organs. His brain, says Mr. Wheeler, quoting Herrick, may be only a tumor, which one day may cause his destruction. Emergence is only another name for creative synthesis, emergent vitalism, organicism, holism.

THE CREATIVE EVOLUTION OF C. C. HURST

(Abstract)

Rev. Charles A. Berger, S.J.

While Hurst's contributions to Genetics have been many and valuable his philosophy of biology is for the most part a bizarre restatement of old errors in new terminology. His mechanism differs from the old materialistic mechanism only in the purely subjective element of being in-

determinate. He bridges the gap between life and non-life by the following series of links: sub-cellular bacteria, ultra-microscopic viruses (filter passers), bacteriophage, genes in the free state, progenes, the Protogene. He rejects the cell as the unit of life and substitutes the gene, his only evidence being a comparison between uncertain estimates of the size of genes and equally uncertain estimates of the size of the bacteriophage and the smaller filter passers. Of real value however, is his attempt at a new concept of species. In place of the old Linnean species he proposes the Genetical species based on a chromosome complex and its gene content. It may be determined by observation and tested by cytological and genetical methods. A clear example is Hurst's reduction of a thousand species and varieties of roses to five basic Genetical Species.

THE MECHANISM OF HOGBEN

(Abstract)

WILLIAM J. WALTER, S.J.

Professor Lancelot Hogben of the University of London in his recent book, "The Nature of Living Matter", formulates the question—What is life?—as follows; Under what empirical conditions is living behavior to be found? This mechanistic outlook ignores both ontology and teleology. Only the question "Why?" is scientific. Hogben willingly admits that he cannot furnish the perfect answer, but, he smilingly adds, neither can any one else.

The dualism in mind and matter is not acceptable to Hogben. The problem of consciousness has been solved in non-teleological terms, conscious behavior has been analysed with reference to a space-time framework by the methods of physical science, and its distinctive characters have been explained by means of "the conditioned reflex". The faculties of the mind cannot be directly observed and so have no objective validity. The modern psysiology of the conditioned reflex has made invalid the distinction between reflex and voluntary behavior; and the boundary between physiology and philosophy is no longer clearly defined. All the faculties of the soul can be explained by Pavlov's conditioned reflex "without recourse to the traditional nomenclature of memory, consciousness, sensation, etc." "Ethical values have been eliminated altogether—Biology is in a position to take over those regions of inquiry which have up to now remained the province of moral philosophy. As a concept of biology, Mind is replaced by Behavior". Behaviorism explains all human actions.

Reproduction according to Hogben, can be explained mechanistically. In non-sexual reproduction, there is no need to postulate that the process of simple fission is different from that of splitting a drop of water into

two. For sexual reproduction, experimentation has offered definite mechanistic indications. Loeb's parthenogenic work has shown that mere physical and mechanical stimuli can perform the function of the living sperm. In the matter of heredity Mechanism has everything its own way. Morgan's Mendelian investigations have furnished us with the gene, a quantitative—and, therefore mechanistic—unit which is the ultimate in all hereditary phenomena.

Such is the doctrine of Hogben. He seems to think that it is justified by science. In reality it is justified only by the rash and unwarranted assumption that where science stops, the human mind that seeks restlessly for the full truth, is also necessitated to end its searchings. When we pass through the field of biology with Professor Hogben and follow his mechanistic principles to their very end, we have not advanced one step nearer to the solution. All the biological facts so far examined have been brought into the category of physico-chemical activities; that indeed, might have been expected, but that is not life. A particular phase is isolated for examination, and the characteristic mark of life is thereby ignored. For that which characterizes life experimentally considered, is the unity, the solidarity of all these particular activities; all converge to one common purpose, the constitution of the living being in its undeniable individuality.

But it is before philosophical criticism that the Mechanism of Hogben seems to give way completely. The very ideas of "The Nature Of Living Matter" according to which it is attempted to reduce all reality to quantitative terms, precludes Hogben from ever attaining the whole of reality. The psychic cannot be explained materially, nor the new reduced to that which is already known. Hogben's formula is; If you wish to understand man, even the highest and best that is in him and his works, study dogs and mice. He makes of experimental science a fetish and forgets that because physics and chemistry can discover only what is physical and chemical in man, it does not follow that man is only a bundle of physical forces and chemical compounds, nor because animal psychology can discover only what is animal in man does it follow that he is animal and nothing more. To understand man, it is necessary to take into account man's totality which is intelligible only in terms of man's destiny and origin. And Professor Hogben with his stimulus-response theory cannot force philosophy to retreat from teleological concepts and to ignore ontological problems.

MATHEMATICS

FERMAT'S LAST THEOREM

(Abstract)

Rev. Joseph P. Merrick, S.J.

When Pierre de Fermat (1608-1665), the greatest writer on the theory of numbers with the possible exception of Diophantus, died at Toulouse, he left a marginal note to the effect that he had solved his great theorem. The theorem is known as Fermat's Last Theorem and is as follows: $u^n + w^n$ is not z^n when u, w, and z are integers and n is an interger greater than two. Although the theorem has never been proved or disproved and much labor has been spent in vain trying to find a single actual case which did not fit the theorem, no one has succeeded in giving a rigid and general proof which admits of no exception. In 1907 the University of Goettingen, Germany, established an award of 100,000 marks, known as the Woelfskell prize for the first successful demonstration of the theorem. The prize however is as yet unrewarded. Nevertheless the attempts for a solution have led to the development of new fields in the theory of numbers, and many interesting problems have been worked out.

Father Joseph Merrick in his presidential address at the meeting of the mathematical section at the convention, presented a proof of this theorem. He asked those present to inspect the proof and discover if possible any error which might have escaped him.

DEFINITION OF A LOGARITHM IN TERMS OF AN AREA

(Abstract)

Rev. Frederick W. Sohon, S.J.

If the logarithm of the number N is defined as the area under the equilateral hyperbola xy = constant between the ordinate at x = 1 and the ordinate at x = N, then the theorem

$$\log x + \log y = \log xy$$

can be proved without using any calculus.

APPLICATION OF THE DISTANCE FORMULA TO THE IDENTIFICATION OF THE GENERAL CONIC

Rev. Frederick W. Sohon, S.J.

If we take $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$
and find

$$B^2 = 4AC$$

then the expression can be written in the form

$$(mx + ny + r)^2 = s(nx - my + t)$$

where

$$m^2 = A \text{ and } n^2 = C$$

and r, s and t can be obtained by solving the equations

$$2mr - ns = D$$
$$2nr + ms = E$$
$$r^2 - st = F$$

Put

$$x' = \frac{nx - my + t}{\sqrt{m^2 + n^2}}$$

$$y' = \frac{mx + ny + r}{\sqrt{m^2 + n^2}}$$

$$p = \frac{s}{2\sqrt{m^2 + n^2}}$$

and the equation becomes $(y')^2 = 2px'$,
the axis of the parabola is the straight line

$$mx + ny + r = 0$$

while the equation of the tangent at the vertex of the parabola is

$$ny - mx + t = 0$$

The case for the hyperbola can be treated in a similar fashion. Here $B^2 > 4AC$, and the expression can be factored in the form

$$(mx + ny + p)(rx + sy + t) = q$$

The equations of the asymptotes then are

$$mx + ny + p = 0$$

and

$$rx + sy + t = 0$$

A PROBLEM IN DIOPHANTINE ANALYSIS

Rev. Joseph M. Kelly, S.J.

The teacher of trigonometry often finds it desirable to drill a class in solving many right triangles without letting the students know or suspect that they are dealing with right triangles. Since nearly every student very soon learns that the triangle whose sides have a ratio of $3 - 4 - 5$ is a right triangle, and is quick to detect that ratio in its multiples, a list of other right triangles whose sides have the ratio of

integers is very convenient and at the same time rather difficult to find in the text-books which the teacher ordinarily has on hand. This paper indicates how such a list may be built up from a simple formula.

We have then as our objective to find out whether there are right triangles whose sides have a ratio that can be expressed in intergers other than 3 — 4 — 5.

The method of procedure is quite simple. Since the sides a, b and c of a right triangle bear the relations expressed in the formula $a^2 + b^2 = c^2$ which may be written $a^2 = c^2 - b^2$, is is only necessary to take the table of squares of numbers and subtract one square from another until we find a pair whose difference is a perfect square. The square roots of these three are evidently intergers, which form the sides of a right triangle. The results of much subtracting appear in the tables (1) and (2):

(1)

c^2	—	b^2	=	a^2
25	—	16	=	9
169	—	144	=	25
625	—	576	=	49
1681	—	1600	=	81
3721	—	3600	=	121
7225	—	7056	=	169
12769	—	12544	=	225

(2)

a	b	c
3	4	5
5	12	13
7	24	25
9	40	41
11	60	61
13	84	85
15	112	113

Looking at the figures in table (2) we notice:

1) b and c are consecutive numbers, as 12 and 13.

2) $a^2 = b + c$ in each case, e.g., $5^2 = 12 + 13$; and $11^2 = 60 + 61$.

3) The values of a are the odd numbers, starting with 3 and taken in order.

4) The value of b in each case can be obtained from its value in the preceding row by adding the sum of the values of a in both rows; e.g., 40 in the fourth row may be found by adding the sum of 7 and 9 to the 24 of the third row.

5) Each value of b differs from the preceding value by a number which is an increasing multiple of 4. In face, b itself is a multiple of 4.

Evidently there is a relation between a, b and c, which can be expressed in general terms and that relation stood out when the table was arranged with numbered rows and b expressed as a multiple of 4.

(3)

n	a	b	b/4
1	3	4	1 x 4
2	5	12	3 x 4
3	7	24	6 x 4
4	9	40	10 x 4
5	11	60	15 x 4

From the last column it will be seen that the coefficient of 4 in any row is equal to the sum of the numbers under n from 1 to the given row, e.g., 10 in the fourth row is the sum of the first four numbers under n, and 15 in the next row is the sum of the first five numbers. Since the numbers under n form an arithmetical series, the sum can be expressed by the formula: $S = \frac{n}{2}\left[2a + (n-1)d\right]$

Here $a = 1$ and $d = 1$, so we may write $S = \frac{n}{2}(n+1)$. Then b written in general terms is $\frac{n}{2}(n+1)\,4$ or $b = 2n(n+1)$.

Since c is the next consecutive number $c = 2n(n+1) + 1$.

The value of a in any row expressed in general terms is evidently $2n + 1$. Therefore, we may start with any number we please and from it form a triangle with sides a equal to $2n + 1$, be equal to $2n(n+1)$, and c equal to $2n(n+1) + 1$. This triangle will be a right triangle, the ratio of its sides being a ratio of integers.

If we wish to use the even numbers as well as the odd in forming triangles, the formula expressing the sides would be found in a similar way to be:

$a = 2n + 2$ $\qquad$ $b = n(n+2)$ $\qquad$ $c = n(n+2) + 2$

Diaphantus in the second century investigated many properties of indeterminate equations, of which $a^2 + b^2 = c^2$ is a familiar example, and has left us a formula far more general than the two given above. If m and n represent any two different integers, then the sides of our right triangle will be:

$a = m^2 - n^2$ $\qquad$ $b = 2mn$ $\qquad$ $c = m^2 + n^2$

A PROBLEM IN MINIMUM VALUE THE ANGLE OF MINIMUM DEVIATION

(Abstract)

Rev. Thomas J. Love, S.J.

The preliminary equations are taken from Osgood's "Introduction to The Calculus", pages 221 and the following. These equations eventually reduce to

$$\frac{\cos\theta}{\sqrt{1 - v^2 \sin^2\theta}} + \frac{\cos\theta^1}{\sqrt{1 - v^2 \sin^2\theta^1}} \left(\frac{d\,\theta^1}{d\,\theta}\right) = 0$$

where $\frac{d\,\theta^1}{d\,\theta} = -1$

It is required to prove that the equation has no solution other than $\theta = \theta^1$ and the function has, therefore, a minimum value. Taking the second derivative of θ^1 with respect to θ in the above equation we find that

$$\frac{d^2\theta^1}{d\,\theta^2} = \frac{\sin 2\,\theta}{n^2 - \sin^2\theta} + 2 \tan\theta$$

which for angles in the first quadrant gives.

$$\frac{d^2\theta^1}{d\,\theta^2} = \frac{+}{+} = +$$

Therefore the function is a minimum.

INTRODUCING THE NATURAL LOGARITHM AND THE EXPONENTIAL FUNCTION

(Abstract)

LINCOLN J. WALSH, S.J.

The natural (or hyperbolic) logarithm of x was defined as the area under the rectangular hyperbola:

$$uv = 1, \text{ between } u = 1 \text{ and } u = x.$$

The function thus defined was shown to obey the addition law:

$$\log x' + \log x'' = \log (x'x'').$$

Introducing the logarithm in this manner possesses for us many advantages over the method now in vogue in many elementary textbooks. Introducing the logarithm thus as a quadrature is in accord with the historical introduction of this function into mathematics, agrees with the method used in higher mathematics for introducing new functions, and finally fits neatly into our course in Freshman Mathematics in which the student is taught to perform quadratures at the very beginning of the course, first graphically and then by means of the Integral Calculus. The Exponential Function may then be introduced as the inverse of the natural logarithm.

In the paper a brief resume was given of Klein's suggestion on passing from the logarithm of Burgi and the corresponding inverse function to the natural logarithm and the exponential function.

INTRODUCING THE TRIGONOMETRIC AND HYPERBOLIC FUNCTIONS

(Abstract)

Rev. Thomas H. Quigley, S.J.

By defining the trigonometric sine and cosine as functions of the circular sector, and the hyperbolic sine and cosine as functions of the hyperbolic sector, several important advantages can be had over the customary mode of introducing these functions. Thus the close analogy between the trigonometric and hyperbolic functions can be stressed, their inverse functions can be defined naturally by means of a quadrature, and more important still, from the teacher's standpoint, these functions thus introduced would fall naturally into place in the mathematical cursus now had in our colleges, giving yet greater unity to the whole.

CHEMISTRY

QUANTITATIVE ANALYSIS FOR COLLEGE STUDENTS

(Abstract)

Rev. Francis G. Power, S.J.

The college course in quantitative analysis should be so conducted as to avoid the two extremes of making it hardly more than a laboratory course in physical chemistry on the one hand, and a course to develop merely routine analysis on the other.

The main theoretical principles involved are: solubility product, co-precipitation, hydrolysis, indicators, and the pH nomenclature; also if possible, the elementary theory of oxidation and reduction. For practical purposes, much drilling on problems is required, since most students are exceedingly weak on arithmetic and would rather do almost any thing except problems.

The laboratory determinations were mentioned, the list being about the same as those in other colleges.

The practical matter of giving a student a grade for his laboratory work is best solved by a statistical study of the performances of many students over a period of several years; the average error (excluding of course those which are so bad as to require the analysis to be repeated) which such a study reveals, may then be taken as a standard average grade, say 70 or 75%, and those who make larger or smaller errors may be graded accordingly. Preliminary figures for this purpose should be available for the next meeting of the association.

RECENT IMPROVEMENTS IN MICRO DETERMINATION OF CARBON AND HYDROGEN

(Abstract)

Rev. Richard B. Schmitt, S.J.

This paper described in detail the improved Pregl method for the micro determination of carbon and hydrogen in organic compounds.

At the University of Graz, Austria, the traditional Pregl methods are held sacred, and they are not prone to change these methods. In all micro quantitative analysis, all parts of the apparatus and all chemicals used are liable to be sources of error. It is desirable, of course, to lessen these sources of error.

In the Pregl method for the determination of carbon and hydrogen results are usually high. It has been discovered by Dr. Joseph B. Niederl, New York University, that two sources of error are corrected by purifying the oxygen and by standardizing the internal conditions of the absorption tubes.

a) Purification of the Oxygen.—Commercial oxygen is made by the Linde process or by electrolytic process. Because of the high pressure machinery used in the Linde process, small particles of lubricating oil adhere to the molecules of the oxygen gas. In the electrolytic process, small amounts of hydrogen are usually found mixed with the oxygen.

The oxygen containing small quantities of lubricating oil and hydrogen, may be removed by the proper absorbents, before it enters the combustion tube.

b) Standardizing the Absorption Tubes.—Before and after the combustion of the organic substance, both absorption tubes are swept out with the same amount of clear, dry air. The air is allowed to bubble through sulphuric acid and sucked through the tubes by means of a Mariotte flask.

PANDEMIC CHEMISTRY

(Abstract)

Rev. Thomas P. Butler, S.J.

The purpose of this paper was to start discussion concerning the two semester culture in pandemic chemistry given to the arts students. The meaning of the term "pandemic" was explained. It was pointed out that only about one-eighth of any so-called general chemistry text book treats of organic substances, in spite of the fact that at least two-thirds of the chemical reactions and substances familiar to everybody are organic in their nature. More analytical, physiological and physical chemistry should be introduced, while the chemistry of many compounds which are discussed in common text books, but which are rare substances outside the chemistry laboratory, should be omitted. The purpose of pandemic chemistry is to make the student familiar with the technical

language and inductive reasoning of the chemist, and with these tools, to enable him to give a logical explanation of the common phenomena of nature. Theory or the explanation of facts should therefore predominate the course, and the facts chosen should be the more common ones. A knowledge of simple arithmetical proportion is all the mathematics required as a prerequisite for the course. The course should be pandemic or truly general, covering in its broad scope all the principle branches of chemistry.

EFFECT OF NON-ELECTROLYTES ON THE PRECIPITATION OF ISO-ELECTRIC GELATIN

(Abstract)

Rev. Joseph J. Sullivan, S.J.

It is known that colloidal solutions of gelatin will migrate towards an electrode under the influence of an electric field, depending on the H-ion concentration. At one determined concentration the gelatin micelles seem electrically neutral. This is called the iso-electric point and it occurs at pH 4.7. If this electrically neutral gelatin (iso-electric gelatin) is dissolved in water, it may be precipitated by various dissolved salts (electrolytes). The purpose of this work was to find out the effect of non-electrolytes on the precipitation of iso-electric gelatin at varying H-ion concentrations.

The procedure was as follows. 1 gram of gelatin (Eastman Kodak Co.) was dissolved in 99 grams of distilled water. This solution was then made up to a definite pH by the addition of previously determined quantities of standard HCl or NaOH. This solution was then divided into two parts, one for precipitation, one for electrometric determination of pH, as a check on the calculated acidity. In the pH work, a H-electrode was used, as quinone and its homologues precipitate gelatin. For precipitation study, 2 cc. of the isoelectric gelatin solution, just prepared, were added to 10cc, of precipitant in a 15cc. centrifuge tube, graduated in tenths. It was centrifuged for four minutes in each instance and the volume of precipitate read. All this work was carried on at 30° C.

The data were tabulated as follows: Volume of precipitate against a given pH. The precipitants (non-electrolytes) were Methyl, Ethyl, Normal Propyl and Normal Butyl Alcohols, Tannin (1%), Formalin, Quinone (0.4%), Ethyl Carbamate, Phenol, Triethanolamine, Thymol.

The results showed maximum precipitation at the iso-electric point, 4.7. Alcoholic groups appear to be conducive to precipitation. Though there is no mention of quinone changing to hydroquinone in the literature, it would appear from the above results that this takes place. Ethyl carbamate seems to hydrolyze to give ethyl alcohol. Triethanolamine and Formalin are poor precipitation agents.

It was noted that precipitation was more complete on the basic side of the iso-electric point. Ethyl alcohol has been recommended as a precipitant. But N-propyl alcohol and phenol are just as good, and phenol is better. Eurethane (Ethyl Carbamate) is excellent.

AMINO ACID CYSTINE IN ANIMAL ORGANISMS

(Abstract)

ALBERT F. MCGUINN, S.J.

The paper reported the work done in the Fordham University laboratory to determine whether the animo acid cystine is available in the animal organism for the detoxication of brombenzene, when no cystine or even sulphur compounds at all are present in the diet. Since brombenzene requires one molecule of cysteine (the reduced form of cystine) to be detoxicated as p-bromphenyl mercapturic acid, the problem resolved itself into the detection of this acid in the urine of dogs who had been starved several days, then given a protein-free diet, in which brombenzene was fed. By the use of an improved technique, p-bromphenyl mercapturic acid was found in the urine under these conditions, indicating that in this case the detoxication mechanism, whereby other sulphur compounds needed for other body processes are synthesized from tissue protein.

PHYSICS

WHAT ARE MASS AND MATTER?

(Abstract)

Rev. J. Joseph Lynch, S.J.

The answer to the question might be given in a sentence—we do not know. The purpose of the paper is not so much to answer the question as to promote discussion as to what they might be.

The classic definition of mass given in all texts on Physics is, "The amount of matter in a body," but of late years we read in texts that mass changes with velocity—mass changes with temperature. Does this mean that the amount of matter in a body is constantly changing? Again, matter is said to change into energy. Does this mean that the matter ceases to exist?

Physicists have never been able to measure mass directly. Indirectly we have several ways of measuring it. We can measure a body's mass by measuring its inertia or its resistance to motion. So measured our unit of mass, the gram, is the amount of matter that requires one dyne of force to impart to it an acceleration of 1 cm. per sec. per sec. A piece of matter requiring a force of 10 dynes to impart to it an acceleration of 1 cm. per sec. per sec. would thus have a mass of 10 grams. One way of measuring mass then is to divide the force applied to a body by the acceleration this force produces $-M\frac{F}{a}-$ the acceleration produced by a force in a body being proportional to the body's mass. Mass so measured is sometimes called inertial mass or mass measured by inertia. How reliable is such a measure of mass? If the same force were required to increase a body's velocity from 25 to 26 cms. per sec. as were required to increase its velocity from 25 to 26 cms. per sec. as were required to increase its velocity from 35 to 36 cms. per sec.—in other words if the inertia of a body were constant, i.e. the same at all velocities, the method would be quite reliable, but we have reason to believe that inertia increases with velocity— that the faster a body moves the greater the force required to make it move faster. If this is so and most modern theories postulate it, inertia is an unreliable measure of a body' mass. Since inertia is not constant it cannot give a constant value of a body's mass. Thus the inertial mass is variable

and changes with velocity. It is in this sense then that mass is said to change with velocity—it is not the quantity of matter but the inertia or resistance of the quantity to motion that changes. We have a parallel to this variable measure of mass in the variable measure of heat. The quantity of heat required to change the temperature of a body from 10 to 11 degrees C. is not the same as the heat required to change the temperature from 21 to 22. It is natural to expect a similar variation in the amount of force required to produce acceleration in a body, i.e. as the amount of heat required to produce unit rise of temperature depends on initial temperature so the amount of force to produce unit acceleration depends on initial velocity.

Mass then would seem to be correctly defined as the amount of matter in a body and as such is an invariable quantity when we say that the mass varies with velocity, we mean rather the inertia of matter or the inertial mass varies with velocity. But if we define mass as the measure of inertia, we are led to other difficulties. An electric charge in motion possesses inertia. As it moves it produces an electromagnetic field about it which resists any increase in its motion or any decrease—a current flowing in a wire is an example of such a charge in motion and an electric current possesses inertia. This inertia may be measured in terms of the charge plus the radius and this measurement of inertia we may logically call electromagnetic mass.

Since the energy of any body in motion may be expressed as the product of the mass times the square of the velocity, we can express the energy of a moving charge in terms of its electromagnetic mass and its velocity. But the electrical energy can be transmitted through space. Therefore, whatever it is that is transmitted through space is something that can be expressed in terms of electromagnetic mass and velocity, but since the energy was sent out into space from the radiating body—a radiating electron for instance—some mass must have been taken from the radiating body and in this sense it is said that matter or better electromagnetic mass, may be converted into energy and vice versa, energy into matter, for when a body absorbs radiant energy it must increase its mass. When the temperature of a body is raised above that of surrounding bodies it sends out heat radiation and consequently radiates part of its mass so that in this sense, mass, i.e. electromagnetic mass, changes with temperature. How then can we define matter as distinct from energy? I prefer to leave the question for someone else to answer.

Radiant energy as we speak of it is in reality energized matter but not structural matter if we might coin such a term, that is to say matter such as bodies are composed of. To give an illustration—steam is vastly different from ice or water and yet it is not so vastly different. It is a much more tenuous form if you wish, of the same matter. Similarly we can picture radiant energy as a tenuous form of structural mat-

ter—structural matter is, if you wish, closely packed radiant energy. One gram of this closely packed energy if converted into radiant energy would produce the heating effect of about 3,000,000 Kilograms of coal. From this it follows that the change in mass, electromagnetic mass—due to change of temperature or radiation is slight. We need a new term which can be applied to structural matter and radiant energy for both in the philosophical sense are matter.

THE REACTION OF THE GYROSCOPE

(Abstract)

Rev. Frederick W. Sohon, S.J.

It was shown that what serves to neutralize the acceleration due to gravity acting on a spinning top is the difference between the accelerations required for the proposed motions and the centripetal acceleration about the instantaneous axis which comes from the elastic reaction to the centrifugal dilatation.

THE UNIT SYSTEM IN PHYSICS

(Abstract)

Rev. John A. Tobin, S.J.

There is tendency in laboratory and lecture work in College Physics to cover too much work in a given time. It is impossible to cover all the units or topics, so the selection of units or topics in the Arts course is of vital importance. The unit must contain some fundamental principles that can be understood by the class and one that has daily life applications. In each unit we have five steps. First is exploration. In the introduction the teacher finds what is known already by the students, and then makes the student realize the need of precise ideas and very accurate observations. The second step is the presentation. In the lectures and lecture demonstrations and in the laboratory experiments the fundamental principle of the unit is explained. The third step is the assimilation. This obtained by the experiment and the individual questioning in the laboratory and in the solution of the problems. The fourth step is the organization. In this step all the facts are placed under a few fundamental principles and these principles are connected with the other units. The fifth step is the examination.

In each unit the development is through the scientific method. First the observation that two quantities vary. Then the ratio of these quantities give a constant. Then the equation that is the major for the solu-

tion of any problem. Omitting all highly technical experiments that depend on the cookbook method for their success and contribute very little to the training of the student, we have made a list of experiments that illustrate the principle given in the unit, and in this way removed the passive state of the student as he merely watched the lecture demonstrations. The other norm in selecting the experiments is quantitative work required in the experiment. If the experiment is purely qualitative, it is used only in the demonstration. In this ways, after the introductory experiments in measurement we have a list of experiments that illustrate the principle of the units that have been selected. For example in Mechanics we have experiments in acceleration, composition and resolution of forces, principle of moments, the pendulum, centripetal force, Hooke's Law, density and Archimedes principle and Boyle's law. In heat, specific heat, fusion, evaporation, and expansion. In the same way the choice has been made of units in electricity, light and sound, and for their explanation of the unit being studied. The experience of the last few years seems to show clearly that the students in the Arts courses are limited by time and aptitude and desire, and so this method does not make the course any easier, in fact more difficult, as each unit must be assimilated for the examination, but it does make the course possible in the limited amount of time that is given to Physics, and does stimulate the students capacity for reasoning, the purpose is to train the student to grasp and hold a few precise ideas, instead of many vague concepts; to measure the quantities very accurately, and to train his mind to reason from the principle to the many applications around him in his daily life.

THE EARTH'S ROTATION AND THE FREE PENDULUM

(Abstract)

Rev. Thomas J. Smith, S.J.

This paper treated of the oval form of the vibrations of the Foucault pendulum in the light of investigation conducted by Fr. Secchi and other experimenters and recorded by Frs. Hagen in the August-September number of POPULAR ASTRONOMY for 1930. It appears that the oval orbit is not due to imperfections or disturbances in the experiment but to the diurnal motion of the earth itself and, as such, is an invariable property of the vibrations. The initial lateral velocity of the pendulum ball is due to the fact that the ball, when drawn back from the vertical and fastened to the wall, is actually in motion as the observing room rotates. The effect of this oval motion is to diminish the apparent deviation of the vibrations expected from the Sine-law. The lateral velocity of the pendulum ball constitutes in itself an added proof of the earth's rotation.

NEWS ITEM

From "The Washington Star", August 23, 1933, Washington, D. C.

PRIEST OFFERS APPARENT SOLUTION TO AGE-OLD MATHEMATICS ENGIMA

An apparent solution of the age-old enigma of mathematics, Fermat's last theorem, was presented before the American Association of Jesuit Scientists, meeting at Georgetown University yesterday, by Rev. Joseph P. Merrick, professor of mathematics at Holy Cross College.

Father Merrick said he had checked and rechecked page after page of his intricate mathematical procedure without being able to find any flaw in his reasoning, and he appealed to other Jesuit mathematicians to try to find the point where he had gone wrong, if it exists.

'It would be presumptious to claim to have solved this problem," he said, since so many have tried and failed. But I wish somebody could show me my mistake."

If his fellow Jesuits cannot find a flaw, he indicated, he will be ready to lay his solution before other American mathematicians and if they agree that he has succeeded, he may make application for the Woelfskell prize.

Prize of 100,000 Marks

The University of Goettingen, Germany, established in 1907 an award of 100,000 marks, known as the Woelfskell prize, for the first successful demonstration of this theorem. But despite hundreds of laborious attempts to win this, the secret has remained in the grave of Pierre Fermat, one of the greatest mathematicians of all time, who died at Toulouse in 1665.

Efforts to solve this problem, while futile so far as their immediate object was concerned, have been responsible for some of the most far-reaching mathematical discoveries of the last three centuries, because of the trains of reasoning which they have aroused.

Fermat himself wracked his brain for years to prove his own theorem, but without success. After his death there was found written by his hand on a margin of one of his books:

"I have discovered a truly remarkable proof which this margin is too small to contain."

He gave no hint as to what his proof was. Ever since, his theorem has had a position in mathematics akin to that of squaring the circle or trisecting the triangle—although it is somewhat more complicated mathematically and theoretically more susceptible of solution. It has, however, attracted little attention among laymen, compared to the more spectacular problems.

Here's the Problem

$X^n + Y^n$ is not Z^n, provided "n" is a number greater than 2, cannot be true. X. Y. and Z. of course, can be any numbers whatever greater than 1. In other words, no two numbers can be cubed, for example, or raised to the third power, and their sum equal the cube of any other whole number. The same is true of any two numbers raised to the fourth, fifth or sixth powers, and so on to infinity.

With the squares of numbers it is different. For example, the square of 3—that is 9—plus the square of 4—that is 16— equal 25, which is the square of 5. Such a case could never be found, Fermat said, with powers greater than the square.

This may be proved to the reasonable satisfaction of anybody by experiment. Put any numbers whatsoever into Fermat's theorem and raise them to any power whatsoever. The sum will not equal any other number raised to the same power.

Take for example, 3 and 4 raised to the third power. They become 27 and 64. The sum is 91. There is no cube root of 91, which is a whole number. And so on, presumably, to infinity. There is no use testing it. The world's most celebrated mathematicians have spent weeks trying to find a single actual case which did not fit the theorem, and have failed.

Possibility of Exception

But this it not a proof acceptable to mathematicians. So long as proof remains impirical there is always the possibility of an exception. And since the number of numbers and powers to which they can be raised are both infinite, everybody in the world might cover sheets of paper with figures 24 hours a day forever without finding an exception and still not prove that there could be no exception.

What is demanded is conclusive proof that there cannot possibly be an exception.

Says the Encyclopedia Brittanica: "Everything indicates that it is true, although it has not been proved. That it has not been proved is one of the most amazing facts in present-day mathematics, and for this reason alone the great celebrity of the problem is perhaps justified. The many attempts to solve it by competent mathematicians have led to a number of remarkable developments in theory, including very abstract conceptions and profound results arrived at after long chains of reasoning. The offering of the Woelfskell prize has led to several thousand erroneous proofs."

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Brock, Lawrence M., 1930, Weston College, Weston, Mass.

Connolly, James K., 1933, Boston College, Boston, Mass.

Crawford, Rev. Wiliiam R., 1924, Boston College High School, Boston, Mass.

Crotty, Rev. Edward M., 1932, St. Andrew-on-Hudson, Poughkeepsie, N.Y.

Daley, Rev. Joseph J., 1930, Boston College High School, Boston, Mass.

Dawson, Rev. James F., 1923, St. Joseph's High School, Philadelphia, Pa.

Delaney, Rev. John P., 1923, Canisius College, Buffalo, N. Y.

Depperman, Rev. Charles E., 1923, Manila Observatory, Manila, P. I.

Doherty, Joseph G., 1930, Weston College, Weston, Mass.

Doucette, Rev. Bernard F., 1925, Manila Observatory, Manila, P. I.

Dowd, Rev. Austin V., 1930, St. Andrew-on-Hudson, Poughkeepsie, N. Y.

Dutram, Francis B., 1931, Weston College, Weston, Mass.

Fey, Leo F., 1926, Woodstock College, Woodstock, Md.

Frohnhoefer, Rev. Frederick R., 1926, St. Francis Xavier High School, New York City.

George, Severin E., 1933, Fordham University, New York City.

Gipprich, Rev. John L., 1922, Georgetown University, Washington, D. C.

Guicheteau, Armand J., 1932, Ateneo de Manila, Manila, P. I.

Hearn, Rev. Joseph R., 1925, Brooklyn Preparatory School, Brooklyn, N.Y.

Hennessey, James J., 1933, Woodstock College, Woodstock, Md.

Heyden, Francis J., 1931, Manila Observatory, Manila, P. I.

Hogan, Edward J., 1933, Holy Cross College, Worcester, Mass.

Kolkmeyer, Rev. Emeran J., 1922, Georgetown, University, Washington, D. C.

Linehan, Daniel, 1931, Weston College, Weston, Mass.

Logue, Rev. William G., 1923, Holy Cross College, Worcester, Mass.

Love, Rev. Thomas J., 1923, Loyola College, Baltimore, Md.

Lynch, Rev. J. Joseph, 1925, Fordham University, New York City.

McDevitt, Edward L., 1933, St. Peter's College, Jersey City, N. J.

McGowan, George P., Woodstock College, Woodstock, Md.

McGrath, Philip H., 1932, Georgetown University, Washington, D. C.

McKone, Peter J., 1931, Weston College, Weston, Mass.

McNally, Rev. Herbert P., 1922, Canisius High School, Buffalo, N. Y.

Merick, Rev. Joseph P., 1923, Bagdad, Iraq.

Miley, Rev. Thomas H., 1923, 980 Park Avenue, New York City.

Miller, Walter J., 1931, Georgetown University, Washington, D. C.
Moore, Rev. Thomas H., 1923, St. Andrew-on-Hudson, Poughkeepsie, N.Y.
Morgan, Carol H., 1933, Holy Cross College, Worcester, Mass.
Murray, Joseph L., 1928, Weston College, Weston, Mass.
Nuttall, Rev. Edmund J., 1925, Georgetown University, Washington, D. C.
O'Brien, Kevin J., 1933, Woodstock College, Woodstock, Md.
O'Callahan, Joseph T., 1929, Weston College, Weston, Mass.
O'Conor, Rev. John S., 1928, Woodstock College, Woodstock, Md.
O'Laughlin, Rev. Francis D., 1923, Fordham University, New York City.
Phillips, Very Rev. Edward C., 1922, 501 E. Fordham Road, New York City.
Quigley, Rev. Thomas H., 1925, Loyola High School, Baltimore, Md.
Rafferty, Rev. Patrick, 1923, Loyola High School, Baltimore, Md.
Reed, Francis G., 1932, Regis High School, New York City.
Rohleder, Charles H. J., 1931, Woodstock College, Woodstock, Md.
Rooney, Albert T., 1933, Fordham University, New York City.
Roth, Rev. Charles A., 1923, St. Andrew-on-Hudson, Poughkeepsie, N. Y.
Schweder, William H., 1933, Woodstock College, Woodstock, Md.
Sheehan, William D., 1928, Weston College, Weston, Mass.
Smith, Rev. John P., 1923, St. Peter's College, Jersey City, N. J.
Smith, Rev. Thomas J., 1925, Weston College, Weston, Mass.
Sullivan, Rev. Daniel H., 1923, 45 Cooper Street, St. Mary's Rectory, Boston, Mass.
Thoman, Robert A., 1933, Woodstock College, Woodstock, Md.
Tobin, Rev. John A., 1923, Boston College, Boston, Mass.
Tynan, Rev. John G., 1926, St. Joseph's College, Philadelphia, Pa.
Walsh, John J., 1933, Georgetown University, Washington, D. C.
Walsh, Lincoln J., 1931, Loyola College, Baltimore, Md.
Welch, Leo G., 1932, Woodstock College, Woodstock, Md.