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Bulletin of the American Association of Jesuit Scientists

EASTERN STATES DIVISION

VOL. XXVIII

JANUARY, 1951

NO. 2

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NOTICE TO AUTHORS

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

TO THE MEMBERS OF THE ASSOCIATION

The Committee for Revision of the Constitution of the American Association of Jesuit Scientists proposes for the consideration of its members the following revised Constitution. This present printing will allow ample time for an examination of the various points of the Constitution. Doubtless, some divergence of opinion will occur in the study of the Articles. The Committee requests that suggestions, corrections, etc., be forwarded as promptly as possible so that a final draft of the Constitutions be prepared for a decisive vote at the annual convention of 1951.

Respectfully Submitted by

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CONSTITUTION OF THE AMERICAN ASSOCIATION OF JESUIT SCIENTISTS (EASTERN STATES DIVISION)

ART. I.

NAME

The name of the Association is THE AMERICAN ASSOCIATION OF JESUIT SCIENTISTS, with the sub-title, Eastern States Division.

ART. II.

PURPOSE

The purpose of the Association is to promote the teaching and advancement of the Natural Sciences and Mathematics in Jesuit Educational Institutions. Among the members, this purpose is to be accomplished by mutual encouragement and stimulation; by presentation and discussion of scientific topics at the annual convention and by publication of papers in the JESUIT SCIENCE BULLETIN, (Art. X; #1 and #2), and in other recognized periodicals.

ART. III.

AUTHORITY

1. The Authority of this Association shall be vested primarily in its members.

2. All matters pertaining to the Association shall be decided by a majority vote of the members (present at an annual convention), unless otherwise specified by the Constitution.

3. The Executive Council, the Governing Board of the Association, (Art. V; §1), shall have delegated authority in matters specified in Art. VI; Sect. IV., and in accord with §1 and §2 of this Article.

4. The Association recognizes the ultimate authority of the Rev. Fathers Provincial in the policy and government of the Association.

ART. IV.

MEMBERSHIP

1. Membership in this Association shall be limited ordinarily to members of The Society of Jesus.

2. Membership shall be comprised of Teachers of the various branches of the Natural Sciences, etc., (Art. II). The condition of membership is the willingness to cooperate in the purpose of the Association. This cooperation is expressed concretely in the attendance, whenever possible, at the annual convention and in the presentation of a paper from time to time.

3. Former Teachers of the subjects mentioned in Art. II, but now engaged in other works, and those occupied in the formal study of these branches, with the view of teaching them, are eligible as members.

4. All applications for membership shall be accepted and approved by the Executive Council, as defined in Art. IV; Sect. IV; §3.

5. There shall be no membership fee. Ordinary expenses of the Association shall be defrayed as set forth in Art. XI.

ART. V.

OFFICERS

1. The Officers of this Association shall consist of a President; a Secretary; a Treasurer; a Representative from each Section, (Art. VII), who shall be also a Vice President of the Association; an Editor-in-Chief of the *JESUIT SCIENCE BULLETIN*, (Art. X). These Officers shall constitute the Executive Council, the Governing Board of the Association.

2. The President, Secretary and Treasurer shall be elected by the members of the Association. The Vice-President shall be elected by the members of their respective Sections.

3. The President shall be elected for one year and shall assume office immediately after his election.

4. The Secretary and Treasurer shall be elected for a term of three years and may be reelected.

5. The Vice-Presidents shall be elected for a term of three years.

6. The Editor-in-Chief of the *JESUIT SCIENCE BULLETIN* shall

be appointed by and his term of office determined by the Executive Council.

7. The elections are to be held at the end of the annual convention.

ART. VI.

DUTIES OF THE OFFICERS

I. DUTIES OF THE PRESIDENT.

1. He shall preside at all general meetings of the Association.
2. He shall preside at all the meetings of the Executive Council.
3. He shall deliver the Presidential Address of the Association.
4. He shall conduct all business of the Association with the Rev. Fathers Provincial, in accord with Art. III, ¶4, and shall act in other necessary matters, with the approval of the Executive Council, as the occasion demands.
5. He shall appoint Committees to facilitate the conducting of the annual convention.
6. He shall be a member of the Executive Council for two years, immediately following his term of office.

II. DUTIES OF THE VICE-PRESIDENTS.

1. They shall preside at all meetings of their respective Sections.
2. They shall deliver the Presidential Address in their Sections.
3. They shall represent their Sections at the meetings of the Executive Council.
4. They shall be Associate Editors of the JESUIT SCIENCE BULLETIN and shall assist the Editor-in-Chief in matters pertaining to the publication of the BULLETIN.
5. They shall arrange the program of the annual convention for their respective Sections.
6. In the absence of the President, a Vice-President, chosen by a majority vote of the Executive Council, shall act as President and fulfill the duties of the President.

III. DUTIES OF THE SECRETARY.

1. He shall act as Secretary of the Association and of the Executive Council.
2. He shall preserve a record of the transactions of the meetings of the Association and of the Executive Council.
3. He shall have charge of the membership list of the Association.
4. At the annual convention, he shall submit a report of the transactions of the Association for the preceding year.
5. He shall arrange the program of the general meetings of the annual convention and shall coordinate the programs of the Sections with the Vice-Presidents thereof.
6. He shall assist the Editor-in-Chief of the BULLETIN in the publication of the proceedings of the Association.

IV. DUTIES OF THE EXECUTIVE COUNCIL.

1. The Executive Council shall be the Governing Board of the Association.
2. It shall define the policy of the Association.
3. It shall accept and approve of new members.
4. It shall determine the time and place of the annual convention.
5. It shall have general charge of the publication of the JESUIT SCIENCE BULLETIN.
6. It shall appoint the Editor-in-Chief of the BULLETIN. (Art. V; §6).
7. It shall convene at the beginning and at the end of the annual convention and at other times at the summons of the President.

V. DUTIES OF THE TREASURER.

1. He shall have charge of matters financial in the Association.
2. He shall submit annually a report of the financial status of the Association to the Executive Council and to the Association.

VI. DUTIES OF THE SECRETARIES OF THE SECTIONS.

1. They shall keep a record of the transactions and of the membership of their respective Sections.
2. They shall assist the Secretary of the Association in keeping the membership list of the Association up to date.
3. They shall submit a report of the activities of their Sections to the members thereof, at the annual convention. They shall report to the Association the results of elections in their respective Sections.
4. They shall assist the Vice-Presidents of the Association in preparing the programs of their Sections for the annual convention.

ART. VII.

THE SECTIONAL GROUPS

1. The Sections of the Association now constituted are six: Astronomy; Biology; Chemistry; Mathematics; Physics; Science and Philosophy. Other Sections may be formed hereafter according to the growth and needs of the Association.
2. The members of the Association shall be enrolled in particular Sections, according to their teaching office or special interests.
3. Each Section shall elect its own Presiding Officer, who shall be, ipso facto, a Vice-President of the Association and a member of the Executive Council, according to Art. V. §1.
4. Each Section shall have a Secretary, elected by the Section. His duties are specified in Art. VI; Sect. VI.

ART. VIII.

MEETINGS

1. There shall be held an annual convention of the Association and of its Sections at a time and place determined by the Executive Council, as stated in Art. VI; Sect. IV. ¶4.

ART. IX.

PROCEEDINGS

1. At the annual convention, there shall be a general meeting, at which scientific papers of universal interest shall be read and discussed. In the Sectional meetings, topics which are of interest to the members of the respective groups shall be discussed. These may include results of research, class and laboratory demonstration, historical and educational investigation, recent developments in Science, etc., as judged proper by the Vice-Presidents of the Sections. (Art. VI, Sect. II. ¶5.)

2. There shall be a business meeting at the beginning and at the end of the annual convention.

3. Further meetings and agenda may be determined by those in charge of the annual convention.

4. These proceedings shall be edited and published annually, under the direction of the Executive Council. (Art. VI; Sect. IV. ¶5.)

ART. X.

PUBLICATIONS

1. The Official Organ of the Association is the periodical entitled: THE JESUIT SCIENCE BULLETIN, (Eastern States Division), published quarterly.

2. It shall contain articles of scientific interest, such as mentioned in Art. IX, ¶1, and other matters of interest to the members of the Association, in accord with the purpose as stated in Art. II.

3. The JESUIT SCIENCE BULLETIN shall be edited by an Editor-in-Chief, appointed by the Executive Council, (Art. VI; Sect. IV, ¶6), who are also the Board of Associate Editors.

4. The Board of Editors shall have discretion in all matters submitted for publication in the JESUIT SCIENCE BULLETIN.

ART. XI.

FEES AND EXPENSES

1. In accordance with Art. IV. ¶5, there shall be no membership fee.

2. Ordinary expenses of the Association shall be defrayed by a "pro rata" assessment upon the members of the Association or by other means determined by the Executive Council.

ART. XII.

AMENDMENTS TO THE CONSTITUTION

1. The Constitution of the Association may be amended by a majority vote of the members present at an annual convention, subject to such restrictions as may arise from the special nature of the Association.

2. In urgent cases, the Executive Council may effect a particular amendment, subject to a decisive vote of the Association.

Science and Philosophy

SENSE PERCEPTION AND THE MICROSCOPICS

JOSEPH P. KELLY, S.J., Weston College

The five senses of man and their operations are the ultimate source of all human cognition. We live in a material world. Our knowledge is derived from the material bodies which surround us. Hence, contact between ourselves and the world demands a type of cognoscitive faculty, capable of apprehending material objects. The senses are that medium. This is true for all men, for our ordinary knowledge necessary for daily life and also for professional thinkers, be they philosophers or scientists or historians, etc. "There is nothing in the intellect which was not in some way first in the senses" say the philosophers. The eminent Max Planck expresses the scientific point of view: "Physics is an exact science and hence depends on measurement, while all measurement requires sense perception. Consequently, *all ideas employed in Physics* are derived from the world of sense perception."¹ Few will seriously challenge these statements. If we can accept this position of both scientist and philosopher, face to face with the problem of knowledge, we have here the common ground on which they build their respective "sciences." The fundamental data of the scientist and of the philosopher is the same, viz: the data of sense perception.

It is only a truism to repeat that each sense faculty has its proper object: the eyes for seeing, the ears for hearing, etc. We cannot taste with the hands. Furthermore, all men have confidence in the trustworthiness of their senses. Otherwise life would become impossible. We live by our sense-perceptions. The scientist reporting his experimental observations, does so without fear of challenge from his fellow scientists. He is ordinarily sure of his observations, if not of his conclusions from his observations. Just as the "everyday" man is

¹ Planck. "The Universe in the Light of Modern Physics." P. 7. Norton, N. Y. (Italics ours).

certain that he reads correctly the street car sign—he is justified by the fact that he arrives home as he expected—or reads the correct football score in the newspaper. Mankind lives and acts on the assumption that the sense faculties are unerring, in their proper sphere and under normal conditions. His experience verifies the assumption, as does the experience of his fellow man, who lives and acts in a manner similar to his own. For, all men are endowed with the same sense faculties and the act of perception is common to all men. (This is the basis of the appeal to common sense.) This is why we can have a conversation on the weather, a traffic jam or a scientific experiment, and can understand one another. We all perceive a situation in a similar manner; we express verbally our perceptions and our hearers find an agreement with their own perceptions and ideas.

Hence, we can say that all specialized knowledge, be it in science or philosophy, must be based on these common perceptions and cannot be completely separated from it. There is no radical difference between a scientific fact and an ordinary fact. Therefore, all specialized knowledge must be in conformity with our common knowledge or at least, there should be no logical contradiction between them. The apparent contradictions should be solvable. There is nothing in the intellect which was not first in some way in the senses.

On the other hand, we all clearly recognize the limitation of the senses and sense perceptions. Minute and far distant objects are beyond the scope of the eyes; dim sounds are not always discernible to the ears; degrees of hardness and softness are often outside the sense of touch. So, we have recourse to instruments, precise and delicate, to supply for the deficiencies of the senses. (We do not speak here of the subjective defects of the senses.) But even here, we must depend on the sense observation of the instruments, as Planck notes.

The Microscopic vs. the Macroscopic

Now, the progressive use of scientific instruments has opened up to us a new order of beings, the world of the microscopics, which in many ways is vastly different from the world of large bodies, as normally perceived by the senses. This gives rise to many problems on the relationship between these two worlds. Are our perceptions of large bodies valid when applied to minute objects? To put it more correctly: to what extent can we apply the attributes and properties of the molars to atomic and subatomic particles? The famous question of the extension and continuity of physical bodies comes to the mind. The table on which I am writing appears to the eyes as a continuously extended body; the tactile sense confirms the testimony of the eyes. If one accepts the Atomic Theory of matter, we must conclude that the table is not as continuous as it seems. This theory tells us that there are many relatively large spaces in the table which destroy the continuity. Here is an apparent contradiction between the two. The scientist has been face to face with similar

problems, for example, in the application of the classical Laws of Nature to subatomic particles and also the validity of the so-called "causal process" when applied to these same particles. From these have come Statistical Laws and Indeterminism.

In this conflict of ideas, it would be absurd to reject what has been accepted or proved by other means than physical experiments. For example, we could hardly deny that both large and small bodies have extension. Our measures of both prove the fact of extension. If the subatomics are devoid of extension, why should the scientists try to measure them? Again, if there were no extension in the minute particles, larger bodies composed of these could never have the property of extension. The inextended can never be the real basis of the extended. In the physical order, there is no mathematical point; it is an abstraction. On the same principle, scientists hold to the existence of Laws of Nature in minute bodies. For, if the laws are not operative in these, there would be no "legality" of operation in molar bodies.

This argument is based in the Principle of Sufficient Reason, a principle valid in science as in philosophy. Planck argues on this principle when he claims that the causal process must be operative even in minute particles. Otherwise, he says, we have no logical guarantee for the validity of the statistical accuracy of the laws of nature. The same principle is employed in postulating the existence of the Neutrino. In beta decay, the unbalanced energy factor is accounted for by the existence of the neutrino,—as a sufficient reason—although the existence of the particle has not yet been experimentally varified.

In the analysis of these problems, we must distinguish between, e.g., the *fact* of extension of bodies and the *mode* of extension; between the fact of laws of nature and their mode of operation. We can readily admit the minute particles have continuous extension but that molar bodies have only an imperfect continuity. The minuteness of the particles and their multitude in a body can appear to the senses as continuous but this seeming inaccuracy does deny the fact of extension somewhere in the body. Likewise we can say that the laws of nature are operative in subatomics, even though there is not the one-to-one correspondence that was formerly held for the interpretation of the classical laws. The *fact* of extension belongs to the primary sense data, which must be correct. The *mode* of extension is a further conclusion or judgment which must find its warrant either in some experimental data or in some principle such as the Principle of Sufficient Reason. A similar solution may be applied to the question of the laws of nature and the causal process.

From the scientific point of view, there would seem to be a greater gap between our sense perceptions of large-scale bodies and the knowledge of the microscopics. This is due in part to the limitations of the sciences in general whose "ex professo" scope is to deal with the measurables and the observables. (Although there is no unanimous

agreement among the scientists on the meaning of the observables.) Again, there is a tendency among present day scientists to a more and more abstract form of science through Mathematics. This has created a symbolism which is at times poles apart from the concreteness of classical Physics as well as that of our ordinary sense perceptions. The "model" Physics of Lord Kelvin would have little share in the symbolism of Quantum science. Furthermore, traditional terms have been retained but meanings have been greatly modified. One need but cite the term "wave" or "causality" as examples. These factors among others have given us a "scientific" world which seems far remote from the our common sense world. The real problem is to reconcile these two worlds.

In traditional philosophy, the scope is broader and the elements are more concrete and less symbolic. Even Scholastic Metaphysics, despite its abstractness, is closer to ordinarily perceived reality than Mathematico-physical interpretation of the scientists. Through its general principles we can often apply the properties of the molar bodies to the minute particles. But this may not be done without some justification of the transition from one order to the other, as has been noted with regard to extension. This is generally true, that predication of properties of one order of being, the macroscopic, cannot be transferred to the microscopic unless justified either in experimental data or on some well established principle.

Biology

SITES OF PHOSPHATASE ACTIVITY IN PARAMECIUM CAUDATUM AND PELOMYXA CAROLENINSIS

WILLIAM D. SULLIVAN, S.J.

Gomori (1939) reported for the first time an histochemical method for demonstrating the sites of phosphatase activity in animal tissue. Since 1939, the experiments performed with this test, because of its simplicity, have appeared in the literature numerous times. Gomori has demonstrated the relation between phosphatase and calcification, and in 1943, by a slight modification of his 1939 test, he showed that all cartilage which calcifies is phosphatase positive. Phosphatase activity and its relation to the resorption of glucose in the proximal convoluted tubules of the kidney and in the brush borders of these tubules have been well established by this test. The distribution of phosphatase in the cell nucleus was shown by Danielli (1946); its presence in the eggs of sea urchins by Wicklund (1948); in various cell types of the anterior pituitary of the guinea pig by Abolins (1948); and for the first time, its presence in protozoa by Sullivan (1950).

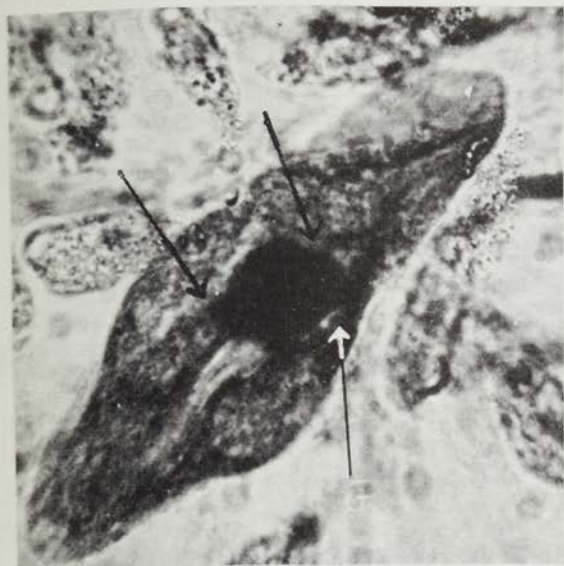


Fig. 1

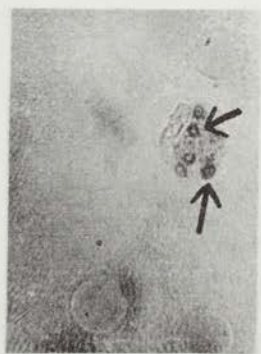


Fig. 2

FIGURE 1

Paramecium caudatum subjected to the Gomori technique for demonstrating the sites of phosphatase activity. Arrows indicate precipitated lead phosphate

FIGURE 2

Two sections of *Pelomyxa carolenensis* subjected to the Gomori technique for demonstrating the sites of phosphatase activity. Arrows indicate precipitated lead phosphate.

With a slight modification, the Gomori technique (1943) was used in the present set of experiments to demonstrate the enzymatic activity of phosphatase in *Paramecium caudatum* and *Pelomyxa carolinensis*.

MATERIALS AND METHODS

The paramecia were cultivated in an hay infusion medium. The hay was boiled for one-half hour and then five grams of this boiled hay was placed in a liter of distilled water. Five days after the medium was prepared, it was inoculated with the paramecia. The pelomyxae were cultivated in a .1 N solution of Chalkley's preparation. The pelomyxae were nourished at intervals of five days with 15 cc. of the paramecia culture. The paramecia culture was first centrifuged and the supernatant liquid was removed. By means of a calibrated pipette the paramecia remaining in the tube were then placed in the pelomyxa culture.

Slides of paramecia were then prepared as suggested by Sullivan (1950). Drops of pelomyxae culture were placed on sterile slides. The slides were then placed in a desiccator with a formaldehyde bath in the lower section of the desiccator. The fumes from the formaldehyde bath fixed the pelomyxae sufficiently to allow the slides to be passed through the alcohols to the distilled water. The slides remained in the desiccator for twelve hours. The Gomori technique was followed from this point to the end of the test.

OBSERVATIONS AND RESULTS

Figure 1 shows the precipitated lead phosphate closely concentrated in and about the nucleus of the paramecium subjected to the test. The lead phosphate appears red and by proper focussing of the microscope the nucleus can be seen to be blue in color. Figure 2 shows the lead phosphate precipitated within the nucleus of the pelomyxae which were passed through the test. Not all the nuclei of the multinucleate pelomyxae demonstrated phosphatase activity. Approximately one out of four nuclei demonstrated the enzymatic activity.

DISCUSSION

Until quite recently it had been assumed that the Gomori test demonstrated the sites of phosphatase activity. Danielli (1946) proved conclusively the reliability of this assumption. At the time of incubation in a solution of sodium glycerophosphate, calcium chloride and a buffer at 37° C for two hours, the still active phosphatase splits the phosphate from the glycerophosphate. This phosphate is trapped at the site of its production and precipitated as calcium phosphate. In the 1939 paper of Gomori this calcium phosphate is then treated with silver nitrate in direct sunlight converting the calcium phosphate to silver phosphate which turns black. The results of this test show the sites of phosphatase activity as golden brown. Instead of being treated with silver nitrate the calcium phosphate may be treated with

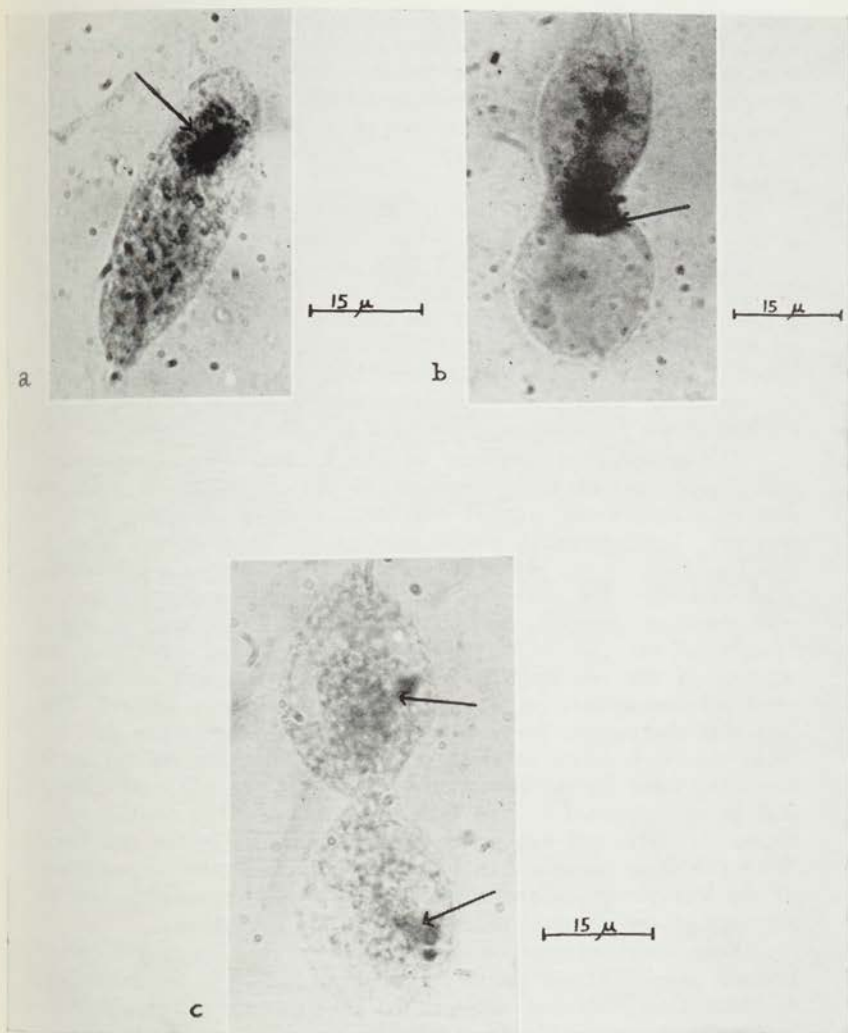


FIGURE 3

Colpidium campylum subjected to the Gomori technique for demonstrating the sites of phosphatase activity.

- a. Arrow points to site of phosphatase activity in *normal* cell.
- b. Arrow points to site of phosphatase activity in *dividing* cell.
- c. Arrows point to site of phosphatase activity in *daughter* cells.

(Sullivan, Wm. D. Trans. of the Amer. Micro. Soc. "Distribution of Alkaline Phosphatase in *Colpidium campylum*", 69: 267-271, 1950.)

cobalt nitrate changing the calcium phosphate to cobalt phosphate which is less soluble than the calcium phosphate. The cobalt phosphate may then be treated with ammonium sulfide converting the cobalt phosphate to cobalt sulfide, which in turn, is less soluble than cobalt phosphate. Those sites where calcium phosphate was first precipitated as a result of the enzymatic splitting of the glycerophosphate substrate will be black.

In the 1943 paper of Gomori, the preformed calcium phosphate is treated with cobalt acetate before the incubation period and the precipitated phosphate is stained later with acridine red. Just why or how the enzyme caused the precipitation of the calcium phosphate is not clear. But the fact that the calcium phosphate is precipitated at the actual site of enzymatic activity and at no other site which may have a strong affinity for the calcium phosphate and the fact that the enzyme in the fixed state corresponds to the normal position of the enzyme in the physiological state have been well established.

The cytoplasmic condition of the hydrogen-ion concentration and the presence of the glutathione in the cytoplasm are both assumed to reduce the alkaline enzymatic activity to negligible proportions. The sulfhydryl groups existing in the cytoplasm have an —SH in place of the —OH of the alcohols, making the compounds more acid than the alcohols. The acidity of the sulfhydryl groups will, therefore, prevent the activity of the alkaline enzyme in the cytoplasm. For this reason, Danielli concludes that apart from its activity in the cell nucleus, alkaline phosphatase will act only in extracytoplasmic sites, i.e. not within the cytoplasm of the cell. The fact that the enzyme may be found within the cytoplasm does not mean that it is active in those sites, but rather that the enzyme is migrating from the nucleus to an extracellular site where its activity will be demonstrated by the Gomori technique. The Gomori technique, therefore, will not demonstrate its presence in the cytoplasm. With this same interpretation the author explains the concentration of the lead phosphate about the nucleus, and the complete lack of any sign of the chemical precipitation in the cytoplasm.

Very little information is available on the function of phosphatase. Danielli claims that it is probably involved in the metabolism of the nucleic acids and nucleotides. He suggested that its presence in rapidly regenerating cells and in the healing skin wounds may aid in the formation of fibrous protein. Sullivan (1950) demonstrated a varying degree of phosphatase activity in the different stages of cell division (Figure 3). The fact that the cell is undergoing division could mean that a greater content of ribonucleic acid is present in the perinuclear cytoplasm, which is confirmatory of Danielli's hypothesis. At the completion of cell division Sullivan found the content of phosphatase to be at a minimum, which is in accord with other investigators (Caspersson, 1940; and Caspersson and Thorell, 1941), who have shown that ribonucleic acid is at a minimum at the completion of cell division. Experiments are now being performed

on the regenerating cells of the *Planaria* and the *Triturus viridens* to substantiate these findings.

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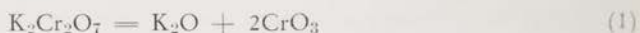
Chemistry

VARIABLE VALENCE AND CHEMICAL STRUCTURE

REV. BERNARD A. FIEKERS, S.J.

That variable valence suggests such fundamentals as the balancing of oxidation-reduction equations seems to be sufficient reason for discussing the topic here. But it also provides in chemistry a foundation for much more than a mere fundamental academic technique. It underlies most of the operations in qualitative and many in quantitative inorganic analysis; it is of certain preparative value in the winning of compounds from their natural sources and in providing new products and reagents; it is the occasion too for studying in a correlative way certain families and periods in the periodic chart of the atoms. And this is one of the foundation stones of all things chemical. It is then the structural approach that will be emphasized in this contribution.

There was a time when "redox" reactions were treated in an analytical way. The oxidant, say $K_2Cr_2O_7$, would be analyzed somewhat as follows:



or perhaps



and the obvious adjustment was made



so that the summation of the overall process is given by



Now it is obvious that the postulate of combined oxides could not serve the equation



which can be balanced by inspection; while more complicated examples of this class would be exceedingly tedious to balance by this method. Out of this tedium have arisen in turn the numerical valence-change method of balancing, the ion-electron method and all of the controversy over both of these methods that preoccupied many chemical educators from the inception of the *Journal of Chemical Education* in 1923 to at least the eve of the second World War. In recent years the appeal to the structural implications of the formulas involved in

a given equation has shown that either the valence-change or the ion-electron method may be used in an equation that involves ions; but that the valence-change method is generally applicable to both ionic and non-ionic equations; and that the ion-electron method is far more elegant where applicable and excludes the possibility of the wrong solution in cases where many solutions are possible according to the valence-change method. This compromise was reached when it was clearly and generally recognized that it is not necessary to give all of the facts or theories in a statement such as a chemical equation, provided that the inadequacy of its expression is understood and that the truth to be emphasized is substantially stated or implied. Further, it seems that some of the proponents of the ion-electron method put such emphasis on ionic equations so as to leave little consideration for those of the non-ionic or organic type. Think of the demonstrations of oxidation and reduction by the flow of electrons only through electrolytic cells with a salt bridge and closed circuit, but without other contact between the reagents. Such cases indeed belong to but a class of phenomena in a vastly larger group of them, which we characterize as oxidation-reduction reactions.

Valence, the combining power of an atom or group under given conditions with a certain number of hydrogen atoms or their equivalent, is in the last analysis an algebraic number, positive or negative, according to the nature of the atoms or groups involved. It is built on conventions, which at times have structural significance and which at times do not. Consider:



On the other hand, the structure of HgCl_2 is $\text{Hg}^{++}, 2 \text{Cl}^-$.

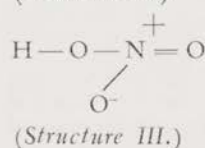
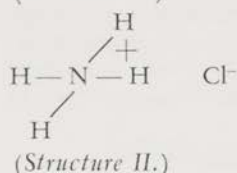
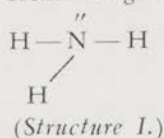
Besides the plus one and plus two valences of mercury, there is its zero valence in the free state. We do not know the structures of all of even the commonest compounds with which we work from day to day. Even some of the simpler structures seem to be quite complex to us at times. We may master the chloride ion from the electronic point of view; speak of the way that chlorine gains an electron on reduction to the ion and the way the ion loses one on oxidation to the element. But apply this reasoning to the permanganate or dichromate and a host of other reagents and we have some complex structural problems on our hands.

If this reflects the curiosity of many who have had to teach chemistry according to these forms, it will pay us to pursue some of the commoner structural aspects of the topic further, thus enriching our teaching background if, and as far as, this may be possible or necessary.

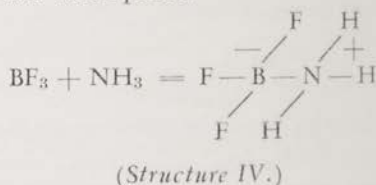
Not all of the elements have variable valence, if we neglect their valence in the free state. Those that have variable valence may be classified as follows:

1. the variation is due to the fact that compounds of these elements contain covalent, co-ordinate covalent and/or ionic bonds;
2. the variation is due to the fact that the element in question has unused or empty orbitals that allow for further bonding by co-ordination;
3. the variation is due to the fact that the element in question can call upon reserve electrons in its penultimate orbits to serve in bonding; (first long period, for example)
4. the variation is due to the fact that the outermost level has both s and p orbitals, their different energy levels allowing for different valence stages;
5. the variation may be due to combinations of the foregoing.

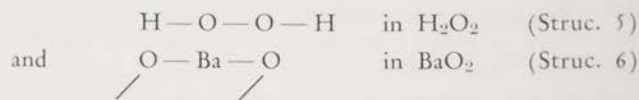
I. TYPE OF BONDING INVOLVED. The classical example here is taken from nitrogen. In ammonia the oxidation state is -3 . Ammonium



chloride, on the other hand, is pentavalent: three covalences, as in ammonia, one co-ordination of a proton, and one ionic valence. But it corresponds to the same oxidation state, namely -3 . In nitric acid, however, nitrogen shows a structural valence of 5, while its oxidation shows a value of $+5$. Consider also other structures in the first short period.



This addition takes place by co-ordination. The difference between the structural tetravalence and the oxidation state of carbon in the series: CH_3OH , CH_2O and $\text{HC}=\text{O}$ OH, is known to all. The existence of peroxides makes a consistent concept of oxidation number very difficult without structural support. Consider



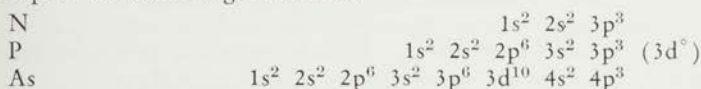
Is the oxygen monovalent in these peroxides, or is the barium sometimes tetravalent?

Exercise I. Write electronic structures for the following: Phosphine, arsine, stibine, nitrogen chloride, nitrogen bromide and nitrogen iodide. Could a theoretical oxide of some rare gas, neon for example, be written?

Exercise II. Show the electronic structures for the series of acids: HCl, HClO, (HClO₂), HClO₃ and HClO₄. What is the oxidation state of chlorine in each case? Can the difference be correlated with the type of valence involved?

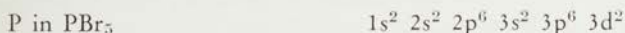
II. UNUSED OR EMPTY ORBITALS. Referring to the ammonia structure (I.), it can be shown that similar structures can be written for the other elements of the fifth group: As, P and Sb (exercise I.). Also the trihalides of these elements are given by similar structures. Pentahalides of nitrogen are unknown, but those of its congeners, P, As and Sb start in this group with P. How are these structures represented?

Compare the following structures



Nitrogen has no d orbitals; phosphorus has as high as five d orbitals, but they are empty. That the third or M energy level can have d orbitals is shown by the configuration of arsenic. The empty d orbitals for phosphorus are written $3d^0$ in order to give them emphasis.

The structure of phosphorus pentabromide has been accounted for by the formation of five covalent bonds between its five 3s and 3p electrons by sharing these severally with the five bromine atoms. It will be noticed that there is only one s orbital and three p orbitals, making a total of four available orbitals at this level. The 3d orbital accommodates the fifth bond. Thus the structure



shows ten electrons in five shared pairs at the outermost level. Similar reasoning probably holds for PF₅ and PCl₅. PI₅ is unknown.

Exercise III. Give the electronic structures of the following: BF₄⁻, AlF₆⁼, SiF₆⁼, SF₆ and UF₆.

There are many limitations on the number of compounds that can possibly be formed by co-ordination. Steric hindrance is the chief one. In the above discussion, our illustrations were limited largely to fluorine compounds, since other halogen atoms or ions cannot be accommodated around the central atom, because of the size of both the central atom and the co-ordinating particles.

Exercise IV. Compare the structure of nitric acid with the various phosphoric acid structures. Look up the structure of phosphorous acid. Show the chemical consequences of this structure.

III. PENULTIMATE ORBITALS. Penultimate orbitals refer to the subshells of the energy levels next to the outermost. Here we consider variable valence in the elements scandium through copper. In this

series manganese shows the greatest variation in valence: oxidation states: 2, 3, 4, 6 and 7 with oxidation state no. 1 in certain complex salts. And so it is selected for illustration.

The normal structure for the manganese atom is given by

Mn Argon structure plus $3d^5 4s^2$
 and argon by A $1s^2 2s^2 2p^6 3s^2 3p^6$

Notice that the five 3d electrons are available for bonding. First the two 4s electrons are lost with about equal ease to form ionic compounds such as $MnCl_2$, $MnSO_4$ etc. with an oxidation number of 2. Manganic compounds use in addition one 3d electron for ionization and sharing. Manganese in the higher oxidation states is generally combined with some other element, such as oxygen in the series MnO_2 , MnO_4^{2-} and MnO_4^- . In a hypothetical way these compounds can be regarded as "ortho" forms of the acids $Mn(OH)_4$, $Mn(OH)_6$ and $Mn(OH)_7$ respectively, which increase in strength as the oxidation number is increased. The structure of the permanganate ion might be described in the following plausible way. It is analogous to the perchlorate ion in that four oxygen atoms are co-ordinated about the manganese. The co-ordinating electrons are the five 3d, the two 4s and the electron lost by the cation. The 4s and the 4p orbitals are thus occupied with eight electrons.

Exercise V. Give electronic structures, identifying initial and final orbitals, of the compounds MnO_2 and MnO_4^{2-} .

Exercise VI. Discuss chromium, including $KCrO_4$ and $K_2Cr_2O_7$, in a similar way.

Exercise VII. What type(s) of bonding lead(s) to even oxidation numbers (compare exercise 2)? to odd oxidation numbers?

The first transition metals, Fe, Co and Ni first utilize the 4s electrons together to form the -ous compounds which are highly ionic in character, Fe^{2+} . These can be oxidized to the -ic state, Fe^{3+} being generally covalent in character, due to the increased charge on the central atom. It is prohibitive to undertake a discussion of the co-ordination compounds of these elements beyond what is required for the treatment of variable valence.

It has been observed that whereas the oxidation of the cobaltous to the cobaltic state corresponds to the general pattern of this transition group, the oxidation of hexa- co-ordinated cobaltous compounds takes place with much greater ease. A study of the electronic configurations throws light on this behavior.

In general, the 3d level has a maximum of five orbitals which can be occupied by at most ten electrons. In cobalt there is one electron in each orbital: with a second electron in one of them for the cobaltic ion; and a second electron in two of them for the cobaltous ion. In co-ordination involving six groups, the 3d, 4s and 4p orbitals

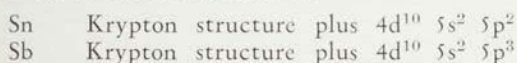
are filled up to their maximum. In the case of the cobaltous ion, however, there is one electron too many. It is ejected to a relatively unstable 4d (Pauling) or 5s (Selwood) orbital. It is easily lost in reaction. Thus cobaltous complexes are powerful reducing agents; are easily oxidized; lose electrons easily.

Exercise VIII. Contrast the electronic structures of hexa-coordinated cobaltous and cobaltic compounds.

Exercise IX. Compare the electronic structures of the ferrous and the cobaltic ions; of the nickelous and the nickelic ions.

IV. VALENCE STAGES IN THE B SUB-FAMILIES. It is the difference in the energy levels of the outermost p and s electrons that accounts for variable valence in the B sub-families. The penultimate shell has a complete quota of eighteen electrons in this sub-family. The p electrons of the outermost shell are more easily removed than the s electrons. Then more powerful oxidants are required for the removal of the remaining s electrons. Having the same energy level, the s electrons are removed together. Since there are always two of them so removed, there is a difference of two between the oxidation states of these elements.

Consider the electronic structures:



By this reasoning tin will show oxidation states of 2 and 4; antimony, of 3 and 5.

It has been observed that in the case of the A sub-families in general, ease of oxidation increases with atomic number; while in the case of the B sub-families, it decreases with atomic number. It would seem that a correlation can be made also by contrasting the ease of removing electrons from the d level of penultimate shells in the case of the A sub-families, with the difficulty of sundering an outermost electron pair in the B sub-families. Compare further, for example, the stabilities of SnO_2 and PbO_2 . The latter is less stable and is thus a good oxidant. Indeed, the instability of the oxides of many heavy metals on heating them, Ag_2O and HgO for example, provides one of the classes of compounds used for the laboratory preparation of oxygen in beginner's chemistry.

Exercise X. With reference to the laboratory preparation of oxygen, compare or contrast the action of heat on the oxides of the heavy metals with its action on the oxides of the light non-metals.

Exercise XI. How many oxidation states does titanium have? Zirconium? Hafnium? To what sub-family of the periodic chart do these elements belong? (Consult chart in Lange, Handbook of Chemistry, 7th ed., pp. 58 & 59 at foot, 1949.)

Exercise XII. Make a similar study for the family: gallium, indium and thallium, showing the electronic structures. Does GaCl_2 exist? Look up also InCl , InCl_2 , InCl_3 and the corresponding thallium structures.

V. ANOMOLOUS VALENCIES. A number of elements possess anomalous valencies. Some defy explanation—some do not: Fe_3O_4 , Pb_2O_3 and Pb_3O_4 , for example. Fe_3O_4 contains one divalent and two trivalent Fe atoms; Pb_2O_3 , one divalent and one tetravalent lead atom; and Pb_3O_4 , one tetravalent and two divalent lead atoms. Similarly Sb_2O_4 is accorded the salt structure SbSbO_4 and Bi_2O_4 is given by BiOBiO_3 .

Geology

TIME SCALE OF GEOLOGICAL HISTORY

JAMES W. SKEHAN, S.J.

The ultimate goal of the science of geology is to decipher the history of the earth as interpreted from the record of its rocks. As such, the historical approach to the subject is employed even when, as is commonly the case, the main objective is of an economic nature. In order to understand geological descriptions, a familiarity with the fundamental units of the time scale of geological history is necessary. For this a summary of the more important divisions of geologic time is presented in Plate 1. In the pages that follow, the general method employed by students in establishing this time-rock sequence will be discussed. A brief description of the more important geological units will also be presented.

The primary basis upon which the establishment of this timetable rests, is the self evident principle referred to as the law of superposition of undeformed strata. This law states that in any region, where stratified rocks are formed by accumulation of sedimentary material layer upon layer, the oldest bed is at the bottom and is overlain by successively younger rocks.

A second principle, drawn from experience but based on this primary principle, is actually of greater value in field work. This principle is referred to as the law of fossil assemblages, and states that certain faunal assemblages are characteristically found in rocks of any particular geological period. This principle is of great value practically because rock formations are frequently found to be deformed by orogenic movements in such a way that unnatural sequences of strata are produced. By means of these fossil assemblages,

TIME SCALE OF GEOLOGICAL HISTORY

Time Units			Orogeny
Cenozoic Era	Period	Recent Epoch	Cascadian Revolution
		Pleistocene Epoch	
		Pliocene Epoch	
	Cenozoic	Miocene Epoch	
		Oligocene Epoch	
		Eocene Epoch	
		Paleocene Epoch	
Mesozoic Era	Cretaceous Period		Laramide Rev.
	Jurassic Period		Nevadian Rev.
	Triassic Period		Palisade Rev.
Paleozoic Era	Permian Period		Appalachian Revolution
	Pennsylvanian Period		
	Mississippian Period		Acadian Rev.
	Devonian Period		
	Silurian Period		Taconic Rev.
	Ordovician Period		
	Cambrian Period		
Pre-Cambrian Era	Proterozoic Period		Killarney Rev.
	Archeozoic Period		Algoman Rev.
			Laurentian Rev.

PLATE I.

rocks may be assigned to their proper place in the time scale and the history of the strata unraveled. This law of fossil assemblages then, is of an inductive nature and is a conclusion drawn from a convergence of available evidence.

The formulation of this law of fossil assemblages began as follows. About the turn of the 19th century, William Smith in observing the Jurassic rocks of England found that each formation had a characteristic fossil fauna different from that above and below. He concluded that this assemblage was identical in all outcrops of the same formation wherever found. Since Smith's time, students of stratigraphy have found that this principle is applicable to fossil-bearing rocks in general. Today this law stands as the immediate, though secondary, criterion for assigning rocks to their positions in the time scale. This principle is of great practical value to the petroleum, engineering, and the field geologist in locating and mapping rock formations.

The following example may illustrate the use of the principle in the field. If a geologist is mapping a rock formation of hitherto unknown age and he discovers trilobites in the beds, he realizes immediately that he is dealing with rocks of Paleozoic age. If some of these trilobites are of the genus *Olenellus*, the student recognizes the formation as of Lower Cambrian age, because no members of this genus have been found in undeformed strata of any other period.

An important method employed in the construction of the complete time scale is that of the correlation of strata. Such correlations are made by establishing relative age relationships between rock formations. This method is very valuable and necessary because the rock formations of no one region constitute a complete record of geologic time. Even if an area were to possess the full sequence, the aggregate would be so thick (approximately 500,000 feet or 95 miles) that the lower beds would be buried completely. Deposition of sediment has been going on in one place or another since the beginning of geologic history, but the "column" is not complete at any one place. For the past 150 years geologists have been discovering fragments of the record and have been piecing them together to form a composite time-scale of earth history.

The general method used in correlation may be illustrated as follows. In the Black Hills and Northern Great Plains all five of the major time-rock units are represented. In this area, however, it has been recognized that the Ordovician beds are immediately overlain by rocks of Mississippian Age. In the Blue Ridge Mountains of Pennsylvania on the other hand, Silurian and Devonian beds overlie the Ordovician, and are in turn overlain by Mississippian strata. By such comparative methods, a composite geologic time-scale gradually has been formed.

The major subdivisions of geologic time have their ultimate basis in diastrophism. This criterion has been chosen because diastrophic movements of continental masses produce such profound and widespread effects that they are recognizable wherever they may exist on any of the continents.

The boundary lines of the major divisions of time are so drawn that they mark the four intervals during which sediments ceased to be deposited in localities represented by present-day land surfaces. The cessation of sedimentary deposition was due to disturbances within the earth, which deepened the deep-sea basins. Such diastrophic activity tended to draw off the water from the shallow continental seas and to leave the continental masses exposed to widespread erosion.

As sediments, derived from the uplifted landmasses, began to accumulate in the deep-sea basins, they displaced an equal volume of water. As a partial result of the enormous quantities of sediment which were poured into the rising oceans, the waters of the sea encroached more and more upon the continental lowlands. Thus the high water stages of any particular period saw rocks being formed over parts of the present continents.

Similarly, eras are subdivided into periods on the basis of relatively less intense orogenic movements called disturbances. The rocks deposited during the interval of time between disturbances constitute a system. Usually the name of a system of rocks is derived from the region where it was first studied in detail. For example, the Cambrian system takes its name from Cambria, the latin name for Wales, where these particular strata were first described.

The rocks of each system usually have faunal or lithologic variations which serve as the basis for further differentiation. For example, the strata of the Pennsylvanian period are divided into four series, the Pottsville, Allegheny, Conemaugh, and Monongahela.

Finally, the local and fundamental stratigraphic unit employed in geologic mapping and description is the formation. It consists of a lithologic unit such as sandstone, shale, limestone or an interbedding of the same. For example, the Silurian sequence at the lower end of Niagara gorge is made up of the Queenston shale, Medina sandstone, Rochester shale, and Lockport dolomite.

The units of geological time discussed in this paper are not to be regarded as representing time in the absolute sense. No two periods of geologic time need represent the same length of time in terms of years inasmuch as a period is merely the time interval between secondary orogenic movements. In certain cases it is possible to correlate these relative time units with absolute time. For the most part, however, at the present state of geological knowledge, this relative time scale of geologic history is quite adequate.

Physics

THE LAMB SHIFT IN THE HYDROGEN SPECTRUM

ROBERT O. BRENNAN, S.J., Woodstock College

Because of the simplicity of the one electron central field problem, the hydrogen spectrum has historically been of great importance in the development of physical theory. The present paper reports some recent developments which spring from post-war use of radar techniques in the investigation of the fine structure of the hydrogen spectrum.

It is quite generally known that the occurrence and actual positions of the observed line series in the hydrogen spectrum were first explained by the Bohr (or "old quantum") theory, while the fine structure of the lines was explained by Sommerfeld in terms of the relativistic change of mass with velocity of an electron moving in an elliptical orbit. Again in the setting of the new quantum theory, the gross structure is given without considering relativistic effect and the fine structure is predicted by the solution of Dirac's relativistic wave equation for the hydrogen atom.

Dirac's theory has long been considered final. Attempts to verify it experimentally had not been successful until 1947. The experimental difficulties were rooted in the fact that the fine structure separation of the lines is of about the same order of magnitude as the "Doppler broadening" of the lines, *i.e.* broadening of the observed lines on account of the thermal motion of the atoms. Whatever evidence could be obtained by statistical analysis of results did not, however, seem to confirm Dirac's theory for the fine structure.

The predicted separation of the levels $2^2P_{1/2}$ and $2^2P_{3/2}$ was 0.365 cm.^{-1} or, in terms of the wave length, 2.74 cm. This is just in the region of the spectrum which became available for investigation as a result of war-time radar developments. A means had to be found, however to bring about transitions between the levels in an atomic beam where the Doppler effect would be reduced. The usual absorption methods would not be satisfactory since the number of atoms in the $2^2P_{1/2}$ state would not be sufficient to cause measurable absorption by excitation to the $2^2P_{3/2}$ level. A new method was used by Lamb and Retherford which depends on the fact that the $2^2S_{1/2}$ level (which according to the Dirac theory coincided with the $2^2P_{1/2}$ level) has a long life-time. The calculated value of this life-time (previous to the work now being discussed) was $1/7 \text{ sec.}$, while that of the $2^2P_{1/2}$ and $2^2P_{3/2}$ levels was $1.6 \times 10^{-9} \text{ sec.}$

A beam of atoms was excited to the $2^2S_{1/2}$ level by bombardment with electrons. If they remained in an excited state they would cause

an emission current when they struck a target. If transitions to the $2^2P_{3/2}$ state took place, the short life of this level would cause them to fall to the ground state before striking the target and no emission current would be detected. The transitions could be brought about by interposing an electromagnetic field, oscillating with the frequency corresponding to the transition, between the point of excitation and the target.

The results of the investigation show that Dirac's theory is wrong in predicting that the $2^2S_{1/2}$ and $2^2P_{1/2}$ levels coincide, but that they differ by about 1000 mc./sec.

The explanations for this discrepancy were not long in coming. It had been realized that Dirac's theory had not taken into consideration any interaction of the electron with the electromagnetic field. Such interactions have been the bane of both classical and quantum electrodynamics, since they have always led to infinite energy terms. Considerable success has, however, been achieved in the last few years in obtaining finite values for such interactions and in particular in calculating the "Lamb shift". This is not the place to attempt to describe the mathematical machinations by which this is done. One can, however, say something of the physical situation which brings about the "Lamb shift."

One of the most important and elementary applications of quantum mechanics is to calculate the energy levels of an harmonic oscillator. One finds something which is quite foreign to the classical way of thinking, namely, that the lowest possible state of an harmonic oscillator is one with the energy $\frac{1}{2}hf$, where h is Planck's constant and f is the frequency of the oscillator. One loses something of his surprise, however, if he recalls that according to Heisenberg's Principle, one cannot know exactly both the position and momentum of a particle. For if the lowest energy level of the oscillating particle were zero, as in classical theory, both its position and momentum would be known exactly since they would both be zero.

Now what has been said of an oscillator may also be said of an electromagnetic field, for an electromagnetic field is equivalent to an assembly of oscillators. One may see this by considering the possible "normal modes" of a black body, or by writing the equations of the field in Hamiltonian form. Or for the present argument, one may take it on faith.

At this point it is important to become appropriately naive and consider what would happen to an electron, which we may suppose to be near the bottom of some potential well, when it is shaken by the so-called "zero-point" oscillations of the electromagnetic field. It is clear that the electron must be raised in the well. If the well is steep it will be raised more than if the well is sloping more gently.

An electron in a hydrogen atom is in a potential well given by the function $-e^2/r$. This is infinitely steep at $r = 0$. Hence if the wave function of the electron is finite at $r = 0$ (we cannot speak of the electron actually being localized there), we may expect that its

energy will be raised when it is shaken by the zero-point oscillations of the field. As a matter of fact, the S wave function is finite at $r = 0$ while the P function vanishes there. Hence we expect that the $2^2S_{1/2}$ level would be separated from the $2^2P_{1/2}$ level and we have a qualitative explanation of the "Lamb shift".

The details of the experimental work and bibliography for the theoretical explanations may be found in an article in the *Physical Review*, vol. 79, p. 549 by Lamb and Retherford. This article appeared August 15 of this year and is preliminary to reports on more precise results. The qualitative discussion given above follows a simple quantitative treatment by Welton (*Physical Review* vol. 74, p. 1157) which seems to derive from Weisskopf. It is perhaps of interest to note that the state of the experimental investigation before the work of Lamb and Retherford is given in Richtmyer and Kennard's *Introduction to Modern Physics*. This section obviously should not be read now without further commentary.

News Items

BOSTON COLLEGE

DEPARTMENT OF BIOLOGY. Approximately 650 students are taking courses in biology this semester. The staff has been augmented by the addition of Dr. H. M. Webb a graduate of Northwestern University last June.

Dr. Bernard J. Sullivan received a grant from the Arctic Institute of North America. This grant and further assistance from the Office of Naval Research enabled him to conduct biochemical research on Arctic animals at Point Barrow, Alaska last summer. He was assisted in this work by a graduate student. Rev. M. P. Walsh, S.J., received a grant last May from St. Luke's Guild of Catholic Physicians in Boston for cytological research with some cancer inhibiting drugs. Five papers have been published in various biological journals by members of the faculty during the present semester.

A new laboratory for graduate students was installed in the basement of the Science Building a year ago. This room has individual cubicles which are used by the graduate students for their private study and research. The graduate department has 20 students working for their Master's degree. Eleven of these are graduate assistants. Courses in Experimental Embryology and Invertebrate Zoology have been added to the graduate curriculum.

The Pre-med Club began the publication of a quarterly bulletin last year. The club has an active program of night meetings and socials for the current year. The regular school meetings are conducted by the students themselves or faculty lecturers.

DEPARTMENT OF PHYSICS. Twenty-one students completed their work for M.S. degrees in Physics this year. At present we have eighteen full time students preparing for their Master's degree. This year they have a choice of three fields for their research problem. The work in electronics and spectroscopy continues, and a new field in advanced acoustics is supervised by Dr. White and Mr. Larson.

The number of seniors majoring in physics this year is seventy. They complete a general course in physics and then take each branch as they advance in mathematics. Optics, heat, mechanics, acoustics, electricity and magnetism, electronics and nuclear physics are the courses given each semester starting in Sophomore after general physics.

A special two weeks' intensive course in "Modern Industrial Spectroscopy" was given at the college from July 24 to August 4, 1950. Fourteen men from all parts of the country and Canada took this course. The spectroscopy laboratory instrumentation included a large 21' 6" grating spectrograph, a Jaco microphotometer, and a Spec-Power source plus the equipment we have at the college.

The Executive Committee of the American Institute of Physics approved the constitutions of the Boston College Student Section and welcomed the section into the national group in October. All members here are now listed as Associate Members of the American Institute of Physics.

HOLY CROSS COLLEGE

CHEMISTRY DEPARTMENT. Enrollment data for September 1950 shows 411 students taking courses in the department each week. This is a slight increase over previous years. The increase is in keeping with the trend of the total enrollment for the college and is to be found specifically in the increase shown by the pre-medical courses in Freshman and in the cultural elective course for Juniors.

Three alumni, B.S. Chem. '50, are studying for their doctorates: two at the Massachusetts Institute of Technology and one at Rensselaer Polytechnic Institute. There are some older alumni still engaged in doctoral work: two at Clark University; one at the University of Massachusetts; two at the University of Connecticut; two at the University of Pittsburgh; three at the University of Notre Dame; and one each at Columbia, Cornell, Syracuse and Ohio State. This makes a total of seventeen men engaged in doctoral work in chemistry.

Recent improvements in the department include the following. The general chemistry laboratory has been equipped with fluorescent lighting, each series of fixtures runs down the center of each of the seven laboratory desks. The course in semi-micro qualitative inorganic analysis is being run in the general chemistry laboratory. Over the past two years the department acquired twelve new balances for quantitative analysis. Another acquisition comes in the form of a Leitz chemical polarising microscope for research purposes and instruction, covered in part by a grant from the Sugar Research Corp. The Beckmann, Model B, Spectrophotometer has already been men-

tioned. Some experimentation is under way to provide better hood facilities in the department.

Prof. VanHook read a paper on Crystallization and Crystal Growth at the Twelfth Summer Conference of the New England Association of Chemistry Teachers, Storrs, Conn., Aug. 21-26, 1950. He also gave a paper on Heats of Crystallization before the Sugar Industry Technicians in New York in May 1950.

The majority of the staff were present at the Science Section Meeting of the NCEA held at Emmanuel College, Boston, in April. The CTRS meeting was included in the program. Prof. Baril attended the Fall CTRS meeting at Regis College in Weston on October 21, 1950. Father Fiekers attended the N. E. Conference of Graduate Study with Prof. VanHook at Boston College, early in May 1950. Fr. Fiekers attended the A. C. S. meeting in Chicago early in September. Some of the staff appeared on the Clark University seminar program last Spring and this Fall.

The *Hormone*, departmental publication in chemistry, now run on a regular monthly schedule, reappeared in October 1950. The October issues for 1949 and 1950 contain the history of the Chemistry Department, 1843-1943, by Charles W. Chagnon. The *Hormone* is now published under the direction of the *Cross and Crucible* Chemist's Club, Student Affiliate Chapter of the American Chemical Society and is sponsored by the department.

On October 17, 1950, *Cross and Crucible* took to the air over campus carrier station WCHC with the program, Miracles of Science, which promises to be a weekly event on this hill. The adventures of chemists on the airways has had a good deal of precedent with the staff of the department since the days of Father Ahern's chairmanship, and was spearheaded by Fr. J. J. Sullivan during the thirties. For students to cultivate the avocation is not all out of keeping with the liberal aims of our brand of education.

DEPARTMENT OF MATHEMATICS. More than 400 students were taking some course in Mathematics during the first semester. Included in this number are 170 upper classmen who have completed at least one year of Mathematics at Holy Cross.

Three graduates of Holy Cross have been appointed Instructors in Mathematics at the University of Maryland. At the same time these men will do further work in mathematics at the graduate school of the university. All three have received the M.A. degree in Mathematics.

Rev. T. J. Smith, S.J., Chairman of the Department of Physics and Mathematics, and Professor V. O. McBrien were delegates to the International Mathematics Congress held at Harvard University in September.

Beginning next term the advanced courses in Higher Algebra and Higher Geometry will be full year courses and will be open only to Seniors.

Rev. William F. Burns, S.J., Assistant Professor of Physics and

Mathematics, is on leave of absence and is doing further study at Fordham University.

A placement examination, covering certain topics from Freshman Mathematics which are important in the study of the Calculus, was conducted by the department on December 12th. About seventy-five upper classmen took the test. Copies of the examination, which was made out by members of the department, will be sent to anyone who is interested.

ST. JOSEPH'S COLLEGE

PHYSICS DEPARTMENT. On November 16 of this year the Physics Journal Club, an activity of long standing at St. Joseph's College, became one of the first organizations of its kind to affiliate with the American Institute of Physics as a student section of that body.

Twenty-one Physics majors at the College have joined as associate members of the A.I.P. and thus enjoy the privileges and benefits explained in recent issues of *Physics To-Day*.

On October 21 Fr. John S. O'Connor presented a paper at the Pennsylvania Conference of College Physics Teachers entitled "Modes of Vibration of a ROTATING String".

As the conference was held at the neighboring College of Haverford, equipment designed to demonstrate the phenomena was set up and displayed at the meeting.

FORDHAM UNIVERSITY

DEPARTMENT OF BIOLOGY. The Biology Department of Fordham University is fortunate in having on its faculty Father Philip O'Neill, S.J., who has recently returned from the Philippine Islands. Father O'Neill is teaching Genetics in the College as well as Educational Psychology in the School of Education.

Father Berger, S.J., Chairman of the Department, has received a renewal of his grant from the National Cancer Institute and is continuing research along cytological lines.

Father Assmuth, S.J., has been appointed Professor Emeritus. He will continue his work as consultant on entomological problems.

Father Haas, S.J., a member of the German Province, has just completed all the requirements for his doctorate. His thesis dealt with the development of striated muscle in *Drosophila*.

Father Schuh, S.J., a member of the New York Province, is completing the requirements for the doctorate. His thesis dealt with a further reinvestigation of somatic reduction in the larval gut of the mosquito.

Father Gruszczyk, S.J., also of the New York Province, has completed the requirements for his Master's degree. His thesis dealt with muscle physiology. The work was done under Dr. Rieser's direction.

Father Hanzeley, S.J., of the Maryland Province is spending

a year at Fordham, brushing up on Mathematics, Chemistry and Physics before going on for an advanced degree in some phase of Biology at an outside University.

Mr. Stouter, S.J., of the New York Province, has completed the requirements for the Master's degree. During his stay at Fordham he worked under Dr. Stout of the New York Botanical Gardens and Father Berger, S.J. He studied the cytology of various species of *Hosta*.

GEORGETOWN UNIVERSITY

GEORGETOWN OBSERVATORY. The professional astronomers who are working in the vicinity of the District of Columbia have welcomed the opportunity to meet at Georgetown University on the second Tuesday of every month for a colloquium. The first meeting was held in November with an attendance of fifty-four. Dr. E. O. Hulburt, Director of the Naval Research Laboratory led a discussion on the light of the night sky from the upper atmosphere. The following colloquium for December was given by Mrs. Simone Daro Gossner of the Naval Observatory on the subject of recent studies of the Milky Way. The next meeting in January will be on the subject of photoelectric observations of occultations of stars by the moon. There are now 110 names on our mailing list; a rather startling census of professional astronomers in this neighborhood.

Georgetown has just acquired a new five inch Ross camera. The lens and camera were made by J. W. Fecker Inc. of Pittsburgh. It will replace the one which was borrowed from Mt. Wilson Observatory nearly three years ago and with which the Georgetown supplement to Dr. Ross' Milky Way Atlas was made while at the eclipse site in Brazil in 1947.

Work on the printing of the pictures for the Georgetown Milky Way Atlas is progressing slowly. It will take a few more months before we have completed the 175 copies of each of 18 plates which will be needed to circulate them among the observatories with which we exchange publications. It took us a good part of the summer to obtain satisfactory negatives on film from the original plates.

The Observatory at Georgetown now has twenty graduate students at various stages along the way toward their degrees. Among those who have obtained their degrees here in the past few years, John P. Hagen (Ph.D. 1949) informs us that he hopes to have the large reflector with a diameter of fifty feet ready for observations of radiation in radio frequencies from stars and parts of the Milky Way by spring; Sister Mary Therese B.V.M. (Ph.D. 1948) who is now at Mundelein College in Chicago expects to spend the summer working at Mt. Wilson Observatory; and John Schombert (M.A. 1950) has been promoted from the Time Service to the Transit Instrument at the Naval Observatory subsequently to obtaining his degree.

FAIRFIELD UNIVERSITY

CHEMISTRY DEPARTMENT. The facilities of the Preparatory Chemistry laboratory have been expanded by the acquisition of several pieces of new equipment and by the purchase of new chemicals. Further expansion of the laboratory, although desirable, is not possible at this time due to lack of available space.

In the Preparatory School at the present there are six Junior year chemistry sections totaling two hundred students. Mr. Kilmartin S.J. and Mr. Scully S.J. teach three sections each.

In conjunction with the program for the Junior-Senior parents' night the Juniors prepared a series of posters and albums on the preparation and uses of industrial chemicals. Many of the pupils showed much interest in this project and some of the posters will be exhibited in the contemplated Bridgeport Science Fair in the future.

The seniors were given a first-hand appraisal of the need for chemists in the world of today by Mr. David Sullivan in an interesting talk given in the Preparatory auditorium. Mr. Sullivan is president of the Fathers' club and is also the chief chemist at the DuPont plant in Bridgeport.

Reviews and Abstracts

THE OXY-ACETYLENE FLAME. 1950. Sound and color 16 mm., 19 min. U. S. Bureau of Mines, Pittsburgh, Pa. The theme of this film is that the "master of metals", most versatile flame on earth serves modern industrial civilization as a portable and inexpensive tool for welding, brazing and cutting metals and alloys. The chemistry of oxygen and acetylene in this connection are indicated in the briefest way. The tool is studied from gas tank through reducing valves, gauges and torch. Its applications in industrial fabrication, repair, demolition and salvage are amply illustrated. Gears are cut from heavy sheet stock almost like cookies from dough. H and I beams are trimmed for the needs of construction. Destroyers yield salvage metals and locomotives are repaired. All in all this is an interesting application of combustion and heat. While the film is not strictly chemical in nature, the time spent in viewing it and gaining background on the topic is a good investment for most teachers and students of the science. This is a joint production of the International Acetylene Association and the Bureau of Mines.

REV. BERNARD A. FIEKERS, S.J.

JESUIT SEISMOLOGICAL ASSOCIATION ANNIVERSARY VOLUME.

The Jesuit Seismological Association has published a twenty-fifth anniversary commemorative volume under the editorship of Fr. James B. Macelwane S.J. Part one of the volume gives the history of the Association during the past twenty-five years (1925-1950). Part two is devoted to a history of the various stations which were set up in our colleges throughout the United States and Canada. Part three is a bibliography of the publications of all those at any time connected with the Jesuit Seismological Association stations in the United States. In this bibliography references to this BULLETIN are many.

PASTEUR, HIS CATHOLICITY. Father Alfred Desautels, S.J., of Weston College, in a letter appearing in *America*, p. 100, 4/22/50, went on a debunking tour anent the almost universal belief in the fervent and pious Catholicity of Louis Pasteur. He quoted three references:

1. an article by Fr. André George in *Etudes*, issue of March 1948. According to Fr. Desautels, Fr. George has done more than anyone else in recent years to dispel the "error concerning Pasteur's supposed Catholicism."

2. a letter from the son of Vallery-Radot and grandson of Pasteur to Paul Dupuy (1939), wherein the following lines appear: "All the literature that has been written on the pretended Catholicism of Pasteur is absolutely false." The source of this letter is not stated in Fr. Desautels' letter.

3. the testimony of Fr. Constant, O.P. (September 21, 1934) that a brother Dominican, Fr. Boulanger, O.P., succeeded in winning Pasteur back to the Faith six months before he died.

We science teachers and pulpit orators are now bereft of a telling story, for Pasteur never said: "I have the faith of a Breton peasant."

REV. JOSEPH A. MARTUS, S.J.

BACK ISSUES OF SCIENTIFIC JOURNALS REQUESTED

Father Hans Müller, S.J. of Sophia University, 7 Kioicho, Chiyodaku, Tokyo, Japan, requests back issues of the BULLETIN with the exception of the following, XXIV 4, XXV 5, XXVI 1, 2, 3, XXVII 1, 2. Fr. Müller is the librarian and is confronted with the task of providing books and periodicals. He would be especially happy to receive any and all numbers of Journals on chemistry, physics and biology.